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c't Digital Photography

The in-depth quarterly for the photo enthusiast

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End-to-End Workflows
in Lightroom, Capture One, ACDSee

Fast Wide-Angles

10 Prime Lenses Tested

Composing with Color

Professional Tips and Tricks

Discovering Landscapes with a 50mm Lens

Telescopes as Budget Telephotos

Leica M Monochrom

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Eagle-Eye Sharpness

Megapixel Monster Canon EOS 5Ds vs. Nikon D810 and Sony a7R
Which Lenses Really Can Resolve 50 Megapixels?

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Winter Issue

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Scott Robert Lim using the α7S
f/1.8, 1/125, ISO 800, Lens: FE 55mm F1.8 ZA

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Dear Reader,

You are looking at the 22nd and, unfortunately, last issue of ***c't*** *Digital Photography*.

Since the first issue in the fall of 2010, we have built up an exclusive and discerning readership, and many of you have become loyal subscribers. We have enjoyed great feedback on our carefully researched technical articles, in-depth tests and inspirational workshops from top names like George Lepp and Roberto Valenzuela. Thanks to everyone who took the trouble to tell us what we did right and what we could have done better.

However, in spite of all the positive news, our readership hasn't grown fast enough to give ***c't*** *Digital Photography* a secure economic footing, and we have been forced to call it a day.

Now that you have to live without us, we recommend that you head over to our sister publisher, Rocky Nook, for all your photographic needs. Visit rockynook.com for an unparalleled range of books and eBooks on virtually every aspect of photography, written by some of the biggest names on today's scene.

We are determined to go out on a high note, so this issue takes a final critical look at the wonderful and sometimes absurd world of digital photography, with our cover story addressing the crucial question "Who needs a 50-megapixel sensor?" But the sheer number of megapixels is not the point – much more important is whether the lens can actually resolve a scene sufficiently well to utilize all the photosites available to it. Most lens geometries simply aren't designed to cope with that kind of pixel density.

We were, of course, skeptical about Canon's 'official' list of recommended lenses, so we decided to run our own tests to see which models are up to the EOS 5Ds challenge. However, even if you find a lens that works in theory, in practice each pixel is so small that it is virtually impossible to capture really sharp images handheld, and a camera that you can't use without a tripod isn't exactly practical.

A big 'thank you' goes to Canon for building the 5Ds and showing us where the megapixel madness leads.

Have fun reading and keep shooting!

Your ***c't*** *Digital Photography* Team

Canon EOS 5Ds R 20

Composing with Color 62

Portfolio

Henrik Spohler conjures up a technological world in which humans no longer belong.

Artist Portrait

Newcomer Michal Zahornacky gives commonplace scenes a new edge with his simple but haunting style.

Canon EOS 5Ds R

Canon's megapixel monster promises medium-format resolution in a full-frame body. We compare it with the competition and check out which lenses have what it takes to utilize all those pixels.

Leica M Monochrom

$7,500 for a camera that can only shoot in black and white? We put the latest monochrome Leica through its paces and try to justify the price.

High-end Car Shoot

René Staud and his team produce ultra-high-end image videos and stills for clients around the world. This article goes behind the scenes in the Namibian desert on a shoot for Mercedes-Benz.

Wide-angle Prime Lenses

We take a look at the fascinating world of wide-angle photography and compare high-end brand-name glass with the third-party competition.

Composing with Color

Photographic artist Pavel Kaplun takes us on a journey to India and lets us in on the secrets of how to use color to turn everyday scenes into magical moments.

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50mm Landscapes 122

Telescope vs. Telephoto

Telescopes are a great value alternative to ultra-long telephoto lenses. We test some popular models and explain how they work, both on and off the camera.

Raw Retouching

Today's raw converters promise 'all-in-one' conversion and editing features. We test some of the most popular commercial and freeware packages and check out whether they really are one-stop solutions

Eagle-eye Cover Shoot

We go behind the scenes on this issue's cover shoot and show you how we captured our fantastic cover image and other shots of large birds of prey.

Landscapes Through a 50mm Lens

Jana Maenz explains how limiting her gear boosted her creativity.

Converting Digitized Negatives

We look at how to use raw converters, dedicated plug-ins and scanner software to get great colors from negatives copied using a DSLR.

About Us

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- Unconventional Light #2: Strobe Workshop
- Fashion Photography with Claire Rosen
- Interview with Photo Artist Jamel Shabazz

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Retouch Pilot 3.6.3

Full version software: *Retouch Pilot* removes scratches, dust particles and other blemishes and restores photos and scans in just a few clicks.

It is often the little spots and blemishes that spoil a photo, and our exclusive full version of *Retouch Pilot* is all you need to restore your images with just a few simple clicks. The program's user-friendly interface offers scratch removal, smart selective healing and auto heal tools. The digital cover stick enables you to retouch skin blemishes and the 'elastic' tool works like the Adobe Liquify tool, enabling you to simply alter shapes and proportions. Alongside its retouching tools, *Retouch Pilot* also offers brightness, contrast, noise reduction and crop adjustments.

You can download a pre-registered version 3.6.3 from www.ct-digiphoto.com/downloads222016 and receive a 50% discount on a purchase of the latest version at www.colorpilot.com/retouch_upgr.html. This offers is valid until March 31st 2016. (tho)

Creating Film Looks with ANALOG projects

Full version software: The filters included with *ANALOG projects* enable you to transform digital snaps into photographs with an authentic vintage analog look.

This easy-to-use software supports JPEG and raw image files and a wide range of presets make it simple to apply looks such as wet-plate, roll film and 'camera obscura' using just a single click. Expert mode includes tools for adjusting the degree of grain, vignette shapes and selective brightness. You can also remove noise, dust, blur, unwanted blemishes and lens spots. The program's 35 post-processing effects include film frames, various lighting styles, bokeh and blur. Individual effects can be shown or hidden as necessary to help you find the right combination of adjustments. For more details, visit www.projects-software.com.

***c't** Digital Photography* readers have access to a full version of *ANALOG projects 1.11.02151* at www.ct-digiphoto.com/downloads222016. All you have to do is follow the two-stage registration procedure included in the software installer. This offer is valid until March 31st 2016. (tho)

Unconventional Light

Video tutorial: Pro photographer Bert Stephani introduces some unusual studio lighting techniques.

Shooting in a studio environment is a great option when it's dark outside or when the weather doesn't play ball. You can control all of your shooting parameters while experimenting and developing your own creative ideas.

In this video, Pro Photographer Bert Stephani introduces some concepts that will help you hone your studio technique. Stephani uses a softbox to provide a soft, flattering main light and explains the differences altered parameters make to the results in easy-to-understand steps. He takes his softbox apart 'layer by layer' to show you how to change its effect and ends up asking whether perhaps a flash would do instead. He puts theory to the test by demonstrating and discussing the various looks you can produce and the types of portrait they are good for. (sea)

Image Processing Tools

Windows

ANALOG projects premium
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GIMP
GIMP Portable
GREYCs Magic Image Converter
Hugin
Inkscape
Inkscape Portable
RawTherapee
Retouch Pilot 3.6.3 **Full Version**
UFRaw

Mac OS

ANALOG projects premium
1.11.02151 **Full Version**
GIMP
GIMP Portable
GREYCs Magic Image Converter
Hugin
Inkscape
Raw Photo Processor
RawTherapee
UFRaw

Linux

GIMP
GIMP Portable
GREYCs Magic Image Converter
Hugin
Inkscape
RawTherapee
UFRaw

Photo Tools

Windows

Enblend/Enfuse
EnfuseGUI
ExifTool
GTKRawGallery
IrfanView
IrfanView PlugIns
IrfanView Portable

Mac OS

Enblend/Enfuse
EnfuseGUI
ExifTool
MacPorts

Linux

Enblend/Enfuse
ExifTool
GTKRawGallery

Sample Images

Camera Test Sample Photos
Lens Test Sample Images
Telescope Photography Sample Images

Videos

Claire Rosen:
Fashion and Fairytales
Jamel Shabazz:
Visual Medicine
Unconventional Light, Part 1:
Softbox Workshop
with Bert Stephani
Unconventional Light, Part 2:
Strobe Workshop
with Bert Stephani
Flicker Produced by an Acuter 90/900 ED Telescope

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Readers' Letters

RAW Converter for Mac

In the latest issue I saw that you have an article planned for the next issue on open source RAW converters. Not sure if it is too late to mention, or if you would be interested, as it is something of a niche, but many have discovered that RPP is probably the best RAW converter for processing files from the unique Super CCD sensor in the Fuji S5 line of cameras. You should try that, and I mean really try that. I also own the latest versions of Lightroom, Photoshop and DxO, and none of them can match the results achievable from this sensor with RPP in terms of DR or color fidelity. I also use a Nikon D800E, Leica M-E and a Sony RX-1 for digital duties, and those files are more easily processed in something like ACR, but none can equal the results I can obtain from the S5 Pro/RPP combo. I don't use RPP very often for the other cameras. Horses for courses. It's an interesting niche, and many still love the 'obsolete' Fuji. In my experience, shooting at base ISO up to ISO 400 for computer display or 8x10 (or smaller) prints, the Super CCD sensor has never been equaled, and RPP has made this clear. Your magazine is the best there is, I should not neglect to say that as well.

Larry Cloetta

Thanks for your feedback. We tested RPP (see issue #20, page 74), but not with the focus on the Fuji S5 as this model was discontinued a couple of years ago.

Linux Performance

I read your article on open source raw converters and felt a need to comment on Linux performance as both a photographer and OS internals expert. Almost all of the open source programs you tested include internal code to test for advanced parameters that allow automatic use of dedicated processors, numeric processing extension and memory. Since these parameters are configured beyond a normal desktop configuration, they require knowledge of how to tune these programs. When properly tuned, Linux can perform image processing over Windows in excess of 2:1. In the future you may want to state the Linux distribution and version, and whether special features are turned on, so expert readers can determine the accuracy of your findings in their Linux environments.

Oliver Bailey

Test Image with Zeiss Otus

I read with interest your review of the Zeiss Otus 85mm f1.4 lens in c't Digital Photography No. 19. It certainly seems to be a fine lens. However I did notice in the test images on the DVD shot at f1.4 that the resolution of the test targets was noticeably softer in the bottom corners of the test photo than in the top corners. There was even some residual softness in the bottom left hand corner at f4. Was this was due to some decentering of the elements in the sample tested or perhaps some accidental misalignment of the test charts?

Graham Wootton

Thanks for your comments. Unfortunately, we cannot reproduce the test scenario after the event, making it impossible to find out what, if anything, went wrong. It is certainly possible that our processes are not always 100 per cent error-free, especially when it comes to testing high-resolution sensors and lenses with shallow depth of field. However, we usually notice erroneous results during our tests and repeat them on the spot if necessary. At this stage, we can't completely exclude the possibility of camera or lens defects either.

Tell us what you think:

We are always happy to receive your comments and suggestions in a letter, an e-mail (editor@ct-digiphoto.com) or at www.facebook.com/ct-digiphoto. We reserve the right to abbreviate your input for publication. Our comments are printed in italics.

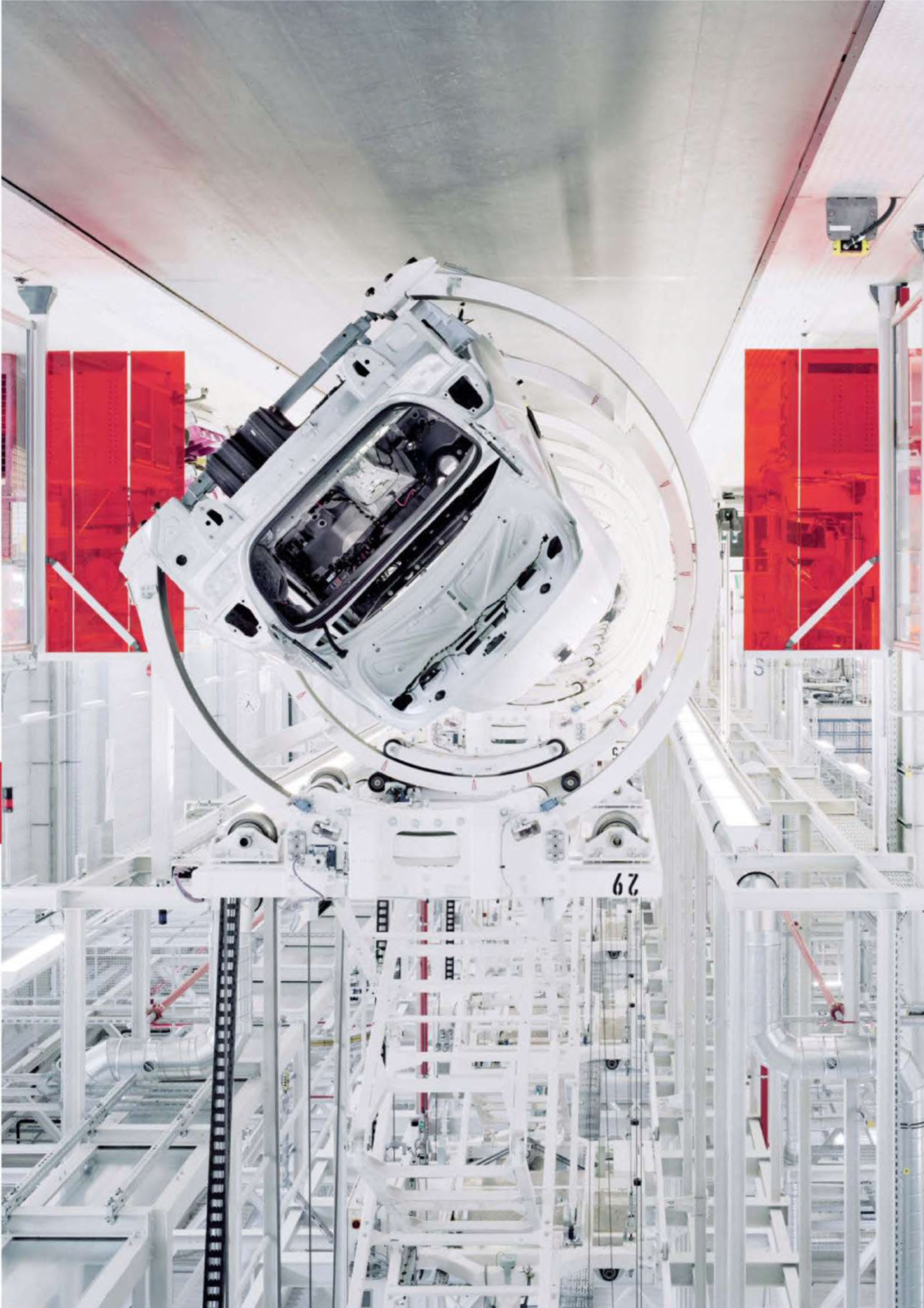
Sony Zoom Not Tested

As a subscriber to your magazine for the past few years I was looking forward to your comparison test of 70-200 lenses (or their APS-C equivalents). When I received issue #21 I was quite disappointed to see that it did not include Sony's 70-200mm f/2.8 A-mount lens, also usable on its FE/E-mount mirrorless cameras via adapter. You tested both the f/2.8 and f/4 variants of the Canon and Nikon 70-200mm offerings but neglected to include the Sony 70-200mm f/2.8 in your test. Why?

I realize that nobody is perfect, and that you generally have limited space in your magazine. However, you also spend quite a significant number of pages on articles that likely have less overall interest than some of your more comprehensive (but not exhaustive) equipment comparisons. Leaving out key products from important manufacturers does not do your readers a good service, many of whom are not Canon or Nikon shooters (though obviously most are). Your equipment reviews generally provide more information than any U.S. based magazine of which I am aware, and you often review equipment that U.S. magazines tend to ignore (such as your flash comparison). You also have more extensive articles on subjects that I suspect are of widespread interest but generally go ignored in U.S. publications, such as making digital copies of slides. Your comparisons and reviews of RAW converters have been quite illuminating. I say all this to let you know that I do appreciate your magazine. I just wish you did not ignore certain types of equipment in your group comparisons and would be a bit more careful and accurate in your reporting.

Mark Van Bergh

Thanks very much for your comprehensive feedback, and we are sorry that your specific interests aren't always represented. We plan our articles and tests very carefully but can't always include all the products we would like to discuss – in this case the Sony bayonet lost out.



Portfolio

Henrik Spohler

Vast monocultures under plastic, colorless server rooms, deserted production lines that look like something out of a science fiction film: Henrik Spohler's images portray an ultra-rationalized world that humans appear to have forsaken.

The Bible says 'Subdue the earth', and that is exactly what mankind has done since the beginning of time. In fact, we have done it so enthusiastically that we now feel we don't belong: we have made ourselves strangers in places like industrial production lines, where it is difficult to know what is actually being produced; in agriculture, where vast monocultures grow under plastic; and server rooms that give no indication whatsoever of what happens in them.

Photographer Henrik Spohler likes to confront the viewers of his images with a world that is empty of people. He has photographed four sequences that treat the concept from different points of view and that he sees as a kind of scientific experiment. "A fast-moving, commoditized world like the one we live in was unimaginable just 30 years ago," he says. "Take Amazon, for example: with a few clicks, I can order something from another country today and it will be delivered to me tomorrow. I ended up asking myself how I could develop a way of showing this process visually."

His first response to that question was his *0/1 Dataflow* series, photographed at places like the DE-CIX Internet exchange in Frankfurt. "Industry used to mold, rivet and weld but here, the product is information. It is immaterial; we percieve it only through the slight noise it makes, but we can't see it." Spohler is professor of Communication Design at the University of Applied Sciences in Berlin and his aim was "to photograph this absurdity using high-resolution photography as a visual allegory of cyberspace."

Global Soul followed in 2008. In this series, Spohler creates a kind of imaginary metafactory in which it appears not to matter what is being produced. "You get the feeling that this metal uterus can actually produce anything and everything," is how Spohler describes this world. It is not only humans who seem out of place here – it is virtually impossible to identify what product is being made.

Are his images pointing the finger? "No, I'm not really political." But he does believe that photography is entitled to ask questions. "I'm not trying to change the world with my photos, but maybe I can create awareness by asking questions and giving people a nudge."

He continued this approach in his third series, *The Third Day*, in which he looks into the conditions under which food is produced and the landscapes our society creates in doing so. "What I'm trying to do in *Third Day* is to exaggerate the fictional as far as possible, giving the impression of an entire universe that is self-contained, but with its origin in plants rather than technology."

He uses similar photographic techniques for all his work: "I try to tell a fictional story by way of artistic documentary photography." As far as a visual language or style is concerned, Spohler does not see himself following the traditions established by the Becher school. "That would be to negate what that style stood for, and there's no use compartmentalizing the things I am trying to convey in that way."

Having covered information and production, Spohler's latest project, *In Between*, looks at worldwide logistics, long the backbone of globalization. "What interests me about harbors, freight airports and railway yards is what these places really look like, since every tiny aspect of them reflects their economic function." In this series, Spohler, who learned his craft on an analog view camera, uses slight overexposure as a clever stylistic technique. "Artistically speaking, it's easier to get a futuristic look by adding a degree of lightness to an image," he explains. "You'll find it difficult to spot anything in my photographs that enables you to date them," he says, "because that perpetually future-focused way of acting and thinking is part of their essence." (keh)

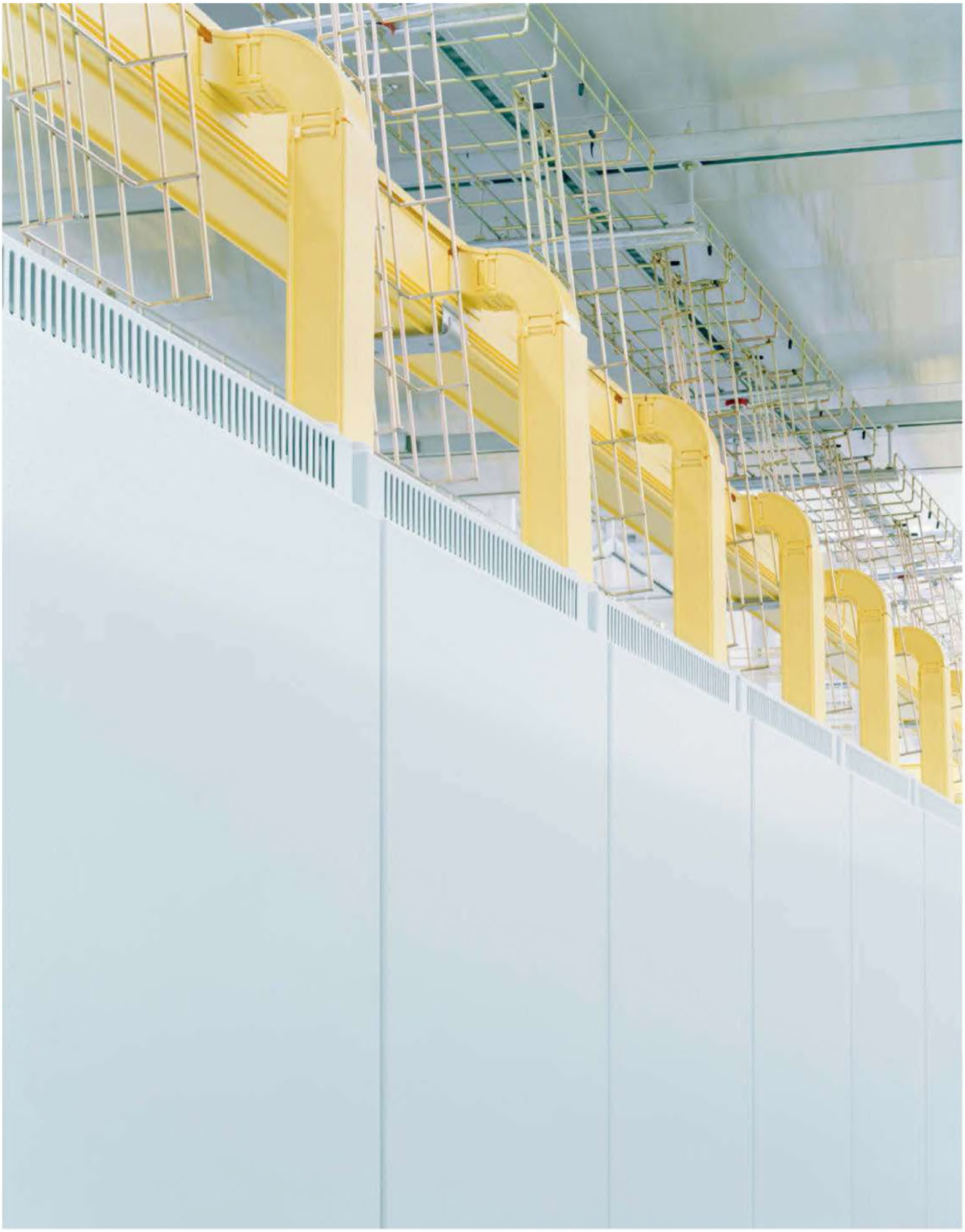
The Third Day
Plant for developing genetically modified varieties of rice, Belgium

The Third Day
Industrial algae production, Germany

For more on Henrik Spohler visit
www.henrikspohler.de

0/1 Dataflow
#1

0/1 Dataflow
#16



0/1 Dataflow
#10

In Between
Container terminals at the Yangshan harbor islands, near Shanghai

Britta Muemmler

Artist Portrait

Making Time Stand Still

Newcomer Michal Zahornacky lives and works in Slovakia and photography is his greatest passion.

Michal Zahornacky's images are designed to appeal to your emotions and get you to reflect. He tells us, "I want people who view my images to take a break from the hectic pace of modern life and think about the simple things." However, all this apparent simplicity requires complex preparation before Zahornacky can transform his ideas into images. His greatest wish is to travel the world on expeditions of discovery.

When Michal Zahornacky decides to do something, he does it right. He bought his first camera four years ago and turned professional two years later. That's how fast things can change when, like Zahornacky, you suddenly discover your true calling. "I always felt the need to articulate my feelings to the world, and I discovered that photography is the perfect medium for doing just that." In a photograph, you can express ideas, feelings and experiences, and you can show transience the cold shoulder too: "Photography allows me to make time stand still and capture a moment forever as I remember it."

The moments Zahornacky captures are mostly everyday scenes and often cover subjects that people don't always like to talk about. The results are frequently quite bleak and force the viewer to think twice. "When a subject troubles me, I like to provide answers or at least get people thinking about it themselves." However, he doesn't see himself as a pessimist: "I try hard to think realistically."

Music is a great source of inspiration and conjures up images and stories in Zahornacky's head. He draws sketches of anything he can't immediately translate into a photo and simply waits for the right moment to come along so he can start shooting.

Nevertheless, he doesn't like to leave things to chance and meticulously sets up each photo. Serendipity only ever takes over in the tiniest of details, such as the wind blowing in a model's hair, which he says is "definitely a bonus."

The Result is What Counts

Zahornacky isn't fussy when it comes to processing and manipulating his images and he says the result is what matters, regardless of how an image was created. "Everyone has their own technique and style, and I respect that." But even for Zahornacky, working with *Photoshop* is of secondary importance. He begins with an idea, then creates a sketch, followed by the shoot itself, and only then performs any digital processing that is required.

Technology, too, is low on his list of critical factors and many of his favorite images were captured using low-end, everyday equipment.

He is also happy to field criticism, especially of the constructive kind. He says, "Objective criticism gives me the incentive I need to improve my work and avoid repeating mistakes I have already made, although when I started out and began publishing images on the Web, I wasn't too partial to critics". In future, he wants to take part in more competitions: "I love it when people appreciate what I do, and winning an international prize would make me really happy." (pen) c't

Michal Zahornacky

To see more of Michal Zahornacky's work, visit www.michalzahornacky.com

Peter Nonhoff-Arps

Even More Megapixels ...

The Canon EOS 5Ds R

The 50-megapixel sensor built into the Canon EOS 5Ds R promises to bring the ultra-high detail quality previously reserved for medium-format cameras to the full-frame market. But do all those megapixels really represent an improvement on the image quality offered by the established high-resolution competition from Nikon and Sony? And which lenses are capable of utlilizing all that resolution to the full? Read on to find out.

In this article

Canon is the third major camera manufacturer to enter the full-frame 'even more megapixels' race in the shape of the EOS 5Ds and 5Ds R models. Both cameras are fitted with 50-megapixel full-frame sensors – the highest resolution yet seen in this segment and, numbers-wise at least, a big step forward from the Nikon D810 and Sony a7R, both of which have 36-megapixel sensors. Nikon's first ultra-high-resolution full-frame camera, the D800E, was introduced in 2012 and offered a serious alternative to medium-format cameras from the start. Back then we concluded that its potential image quality was sufficient to compete with medium-format cameras but that no lenses were available that exploited its resolution to the full. The situation has changed little today, and only the Otus 55mm and 85mm f/1.4 manual-focus lenses from Zeiss (available for Nikon F and Canon EF bayonets) offer true high-end resolving power. The latest-generation a7R II from Sony has now hit the market, but we weren't able to get our hands on one in time to include it in this test. It has a 42-megapixel sensor, hybrid autofocus with 399 focus points and a five-axis in-body image stabilizer.

For this issue's test, we compared the EOS 5Ds R with the Nikon D810 and the 'old' a7R. To keep the playing field level, we tested all three with the 85mm Zeiss Otus (mounted on a Metabones EF- to E-mount T Smart Mark IV adapter on the Sony). We began by testing resolution, dynamic range and noise characteristics in the lab, and used the town hall in Hannover and a studio-based portrait as our real-world test subjects.

We used various standard and non-standard lenses (including the new EF 11-24mm f/4L USM) to see what kind of performance we could achieve with the new camera and to check if these lenses are up to the job of successfully utilizing all that resolution. We also took a closer look at the things you need to consider when purchasing a lens for a camera like this.

But first, let's take a look at the differences between the EOS 5Ds R and the EOS 5D Mark III as well as the underlying concepts, feature sets and handling offered by our three test cameras.

To finish up, we also discuss the challenges involved in day-to-day shooting with such an ultra-high-resolution camera.

Camera Comparison

The main rivals in the current battle for the high-resolution crown are the Canon EOS 5Ds and 5Ds R models, the Nikon D810 and the Sony a7R. The Canons are the newest of these and add ultra-high-resolution models to the EOS 5D lineup. Apart from the slightly lighter color of thier bodies, the new cameras look virtually identical to their predecessor, the EOD 5D Mark III. All the important changes are under the hood.

Comparing Resolution

	Sensor Size	Surface Area	Resolution	Equivalent Full-frame Resolution
Full-frame	24 × 36 mm	864 mm²	50.6 megapixels	50.6 megapixels
APS-C	22.4 × 15 mm	336 mm²	20.0 megapixels	51.4 megapixels
APS-C	22.3 × 14.9 mm	332 mm²	24.0 megapixels	62.5 megapixels
Micro Four Thirds	17.3 × 13.0 mm	225 mm²	16.3 megapixels	62.6 megapixels
Micro Four Thirds	17.3 × 13.0 mm	225 mm²	20.0 megapixels	76.8 megapixels

The Sensor

The sensors in all three cameras have the same 36×24 mm dimensions, which are the same as those in a single frame of 35mm analog film. The 36-megapixel sensors in the Sony and Nikon cameras both measure 7360×4912 pixels, while the Canon's sensor measures 8688×5792 pixels, giving it an overall resolution of almost 51 megapixels.

The non-R version of the EOS 5Ds has a double low pass filter designed to reduce moirés and color artifacts at slanted object edges, while the R version, the Nikon D810 and the Sony a7R all have a second low pass filter designed to cancel out the effect of the first and maximize resolution and sharpness in the captured image. The downside of this system is that it increases the risk of producing moirés in fine details.

In this context, it is interesting to take a look at the differences in pixel density among full-frame, APS-C and Micro Four Thirds (MFT) sensors. If you take a look at the table above, you will see that a 24-megapixel APS-C sensor would have an equivalent resolution of 62.5 megapixels if it were to be scaled up to full-frame size. This is why full-frame lenses won't necessarily produce better results with APS-C sensors than dedicated APS-C lenses, in spite of the larger image circle they produce. Our Micro Four Thirds example is even clearer – 20 MFT megapixels are equivalent to 76.8 megapixels when scaled up to full-frame dimensions.

The EOS 5Ds R has a sensitivity range of ISO 100-6400, which isn't a lot for a contemporary camera. The Nikon D810 offers slightly more (ISO 64-12 800), while the Sony offers ISO 100-25 600 plus a low ISO setting of 50. We will discuss the effects of these differences on noise behavior later on.

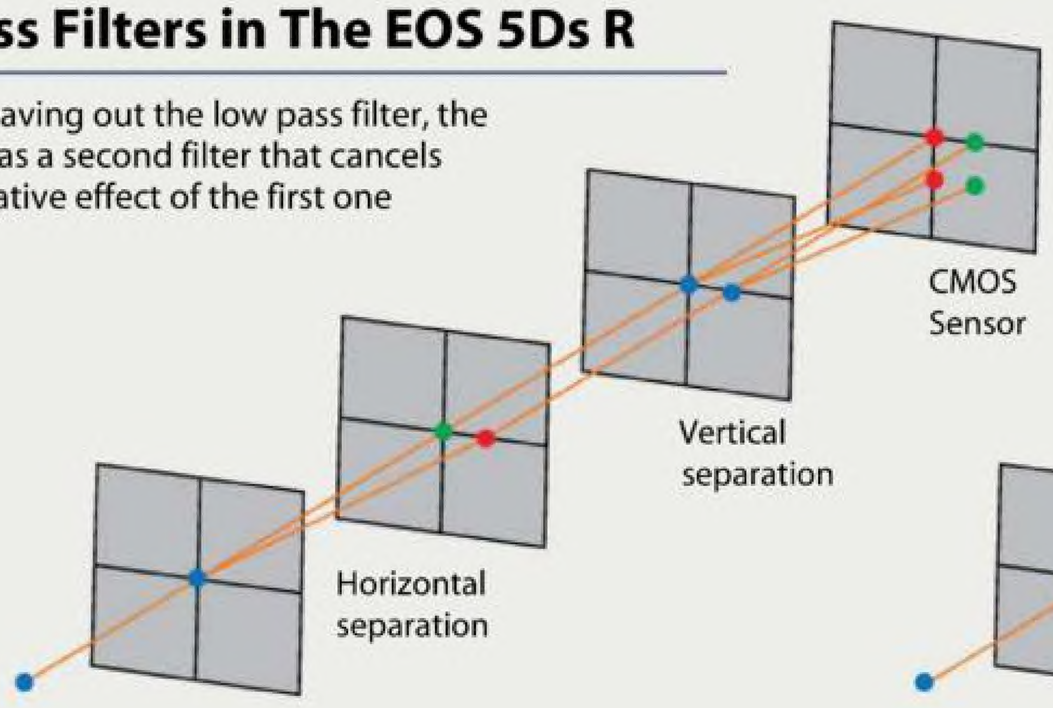
Dealing with Ultra-high Resolution

The high pixel density that a large number of pixels produces means that even tiny camera movements during the exposure have a negative effect on sharpness and detail rendition – a minuscule detail 'slides' from one pixel to the next, making it twice as large in the resulting images. The most obvious antidote to this type of effect is to use a robust tripod. However, for handheld shots, the tried-and-trusted rule of thumb that recommends an exposure time of 1/focal length is no longer valid. At these kinds of resolutions, you will probably need to decrease your exposure time by at least two stops to keep even stationary subjects sharp – in other words, if you are using a 50mm lens, you are better off shooting at 1/250 second than the 1/50 suggested by the old rule.

High-resolution sensors not only make heavy demands on the photographer, the camera's hardware and firmware has to cope with high-resolution shooting too. The EOS 5Ds R has a new mirror mechanism driven by a motor and geared cams rather than the conventional lever and spring model built into the EOS 5D Mark III. This design is said to reduce the tiny vibrations and the noise caused by mirror movements. It also means that you can set mirror lockup simultaneously with a shutter delay of

Low Pass Filters in The EOS 5Ds R

Instead of leaving out the low pass filter, the EOS 5Ds R has a second filter that cancels out the negative effect of the first one



High-resolution Full-frame DSLR Overview

Technical Data

	Canon EOS 5Ds R	Nikon D810	Sony a7R [2]
Sensor size	Full-frame (35.9 mm × 23.9 mm)	Full-frame (35.9 mm × 24 mm)	Full-frame (35.9 mm × 24 mm)
Sensor resolution	50.6 megapixels	36.3 megapixels	36.4 megapixels
Image size	8688 × 5792 pixels	7360 × 4912 pixels	7360 × 4912 pixels
Crop factor	1	1	1
Low pass filter	✓ / – [1]	–	–
Sensitivity	ISO 100-6400	ISO 64-12800	ISO 50-25600
Raw capture	CRW 14-bit	NEF raw 12-bit / 14-bit	ARW 14-bit
Video formats	MOV (MPEG-4 AVC/H.264)	MPEG-4 AVC/H.264	MPEG-4 AVC/H.264
Video resolution (max.)	1920 × 1080 30p	1920 × 1080 60p	1920 × 1080 60p
Autofocus	Phase-detection (contrast-detection in Live View)	Phase-detection (contrast-detection in Live View)	Contrast-detection
AF points	61 (4 1cross sensors)	51 (15 cross sensors)	25 zones
Shortest / Longest exposure time	1/8000 s / 30 s (Bulb)	1/8000 s / 30 s (Bulb)	1/8000 s / 30 s (Bulb)
Maximum burst shooting rate	5 fps	5 fps	4 fps
Viewfinder type / coverage	Pentaprism / 100 %	Pentaprism / 100 %	Electronic (2.4m dots) / 100 %
Monitor type	Color LCD, 3.2"	Color LCD, 3.2"	Color LCD, 3"
Monitor resolution	1,040,000 dots (720 × 480)	1,228,800 dots (640 × 480, RGBW)	921,600 dots (640 × 480, RGB)
Montior articulated / touch control	– / –	– / –	tiltable / ✓
Dimensions (W/H/D)	152 mm × 116 mm × 76 mm	146 mm × 123 mm × 82 mm	127 mm × 94 mm × 48 mm
Weight (incl. battery and memory card)	1.86 lb / 845 g	2.16 lb / 980 g	1.02 lb / 465 g
Suppored memory cards	SD, SDHC, SDXC (UHS-1), 1 × CompactFlash (UDMA)	SD, SDHC, SDXC (UHS-1), 1 × CompactFlash (UDMA)	SD, SDHC, SDXC (UHS-1), Memory Stick Pro-HG Duo
Connectors	USB 3.0, HDMI Type C, stereo microphone	USB 3.0, HDMI Type C, stereo microphone, headphones	USB 2.0, HDMI Type C, stereo mic., headphones, Wi-Fi
Current price (Body only)	$3,900 ($5Ds: $3,700)	$3,000	$1,900

Test Results

	Canon EOS 5Ds R	Nikon D810	Sony a7R [2]
	better ▶	better ▶	better ▶
Sensor resoution (in line pairs)	2896	2456	2456
Center resolution(ISO 100)	2670	2450	2200
Center resolution (ISO 400)	2640	2240	2170
Center resolution (ISO 1600)	2670	2150	2120
Center resolution (ISO 6400)	2380	1990	2040
Dynamic range (ISO 100) (in f-stops)	9.8	9.5	10.1
Dynamic range (ISO 400)	10	9.5	11.3
Dynamic range (ISO 1600)	9.8	9.5	10
Dynamic range (ISO 6400)	8.9	9	9.6
	◀ better	◀ better	◀ better
Visual Noise (ISO 100)	1.3	1.3	1.1
Visual Noise (ISO 400)	1.5	1.5	1.2
Visual Noise (ISO 1600)	2.2	1.9	1.4
Visual Noise (ISO 6400)	3.8	2.5	1.9

[1] The EOS 5Ds R has an additional low pass cancellation filter

[2] The a7R II was introduced shortly after this test was written

✓ included – not included

1/8-2 seconds in a single menu. In previous models, these two settings had to be made separately.

Compared with its predecessor, the Nikon D810, too, has an improved mirror damping mechanism and an electronically controlled front shutter curtain, which is also designed to prevent unwanted micro-vibrations. This system means that the shutter is open at the beginning of the exposure and only closes when it is completely over.

The Canon website makes concrete recommendations regarding which of its lenses produce the best results with the new camera in portrait, landscape and architectural situations. See page 30 for more details.

Canon EOS 5Ds R

The new mirror mechanism and a raft of reworked functions further optimize the 5D shooting experience

Features and Handling

All three test candidates have extremely comprehensive feature sets. Both DSLRs are subject to a process of constant refinement and have seen the addition of many useful features over the years. The main differences lie in the details of the menu system and the custom functions. The EOS 5Ds R has a new white balance setting designed to keep whites neutral in artificial light and, alongside the usual Picture Styles, the Canon has a new Style called Fine Detail that optimizes image rendition for very fine textures and details. This is the default Style and produces excellent JPEG images.The Nikon equivalent Picture Control is called Flat, which ensures that detail is preserved over a wide range of tones, especially in potentially burned-out highlights.

Both DSLRs offer large, bright pentaprism viewfinders with 100 per cent coverage and a wide range of exposure parameter displays. Both have an in-focus indicator that lights up when the subject at the selected focus point is in focus. The D810 version of this feature is bar-shaped and includes an arrow that indicates the direction in which you need to adjust focus if the subject isn't completely sharp.

The mirrorless Sony a7R has an electronic viewfinder that is capable of displaying a zoomed detail of the frame and can be set to adjust its brightness automatically to suit the surroundings. These two features make manual focusing a breeze, even in low light.

Optical viewfinders and in-focus indicators like those built into the DSLRs are not really up to the job when it comes to capturing maximum sharpness, and you need to use live view zoom to be sure of spot-on focusing. You can also set up the camera monitor to automatically compensate for deliberate under- or overexposure. The same is true for the a7R and, although it has no status display on the top of its body, the monitor can be tilted up or down, which is just as practical. The articulated display is also a boon in low shooting positions.

Nikon D810

The 36-megapixel D810 is the best established model among the current crop of high-resolution DSLRs

The Sony has near field communication (NFC) and Wi-Fi functionality for automatic image transfer and camera remote control via the *PlayMemories Mobile* app. You only have to touch the camera with your mobile device to make an NFC connection and you can load other apps from the PlayMemories Store via Wi-Fi.

Neither DSLR has built-in Wi-Fi functionality, which is a shame in view of the extremely high resolution offered by many smartphone screens. These would, in theory at least, make precise live view focusing a lot easier than it is using the camera monitor. Such functionality would also be a great aid to tripod-mounted landscape or architectural shoots. Currently, you can only control the Canon remotely using a USB cable and a dedicated smartphone app such as *DSLR Controller*.

As is to be expected, both DSLRs have phase-detection autofocus systems. The EOS 5Ds R has the same system as the EOS 5D Mark III, with 61 focus points and 41 cross sensors. The Nikon has 51 focus points that, like the Canon, can be grouped to reduce the likelihood of focus errros such as accidental focusing on the background. The Sony has a 25-zone contrast-detection system that is markedly slower than both DSLR systems, although it is faster than the dedicated contrast-detection system both DSLRs use in live view mode.

The EOS 5Ds R and the D810 can shoot burst sequences at up to 5 fps, while the Sony only manages 4 fps.

The Canon's video performance is not up to that of the other two test models, offering only 25p/30p Full HD capture in contrast to the 50p/60p frame rates of the other two. None of our test models support 4K capture.

Handling

The large size of both DSLRs makes handling with a large lens like the 85mm f/1.4 Otus a well-balanced experience, whereas the Sony is simply too small to balance out the heavyweight Zeiss glass. It is much better balanced when used with its dedicated E-mount lenses. At 465 grams, the Sony weighs less than half as much as the Nikon.

All three have easily accessible memory card slots, and both DSLRs support SD and the older CF cards that still enjoy a good reputation among serious photographers. Dual card slots are great for making automatic backups, separate recording of JPEG and RAW files or simply for expanding your camera's shooting capacity.

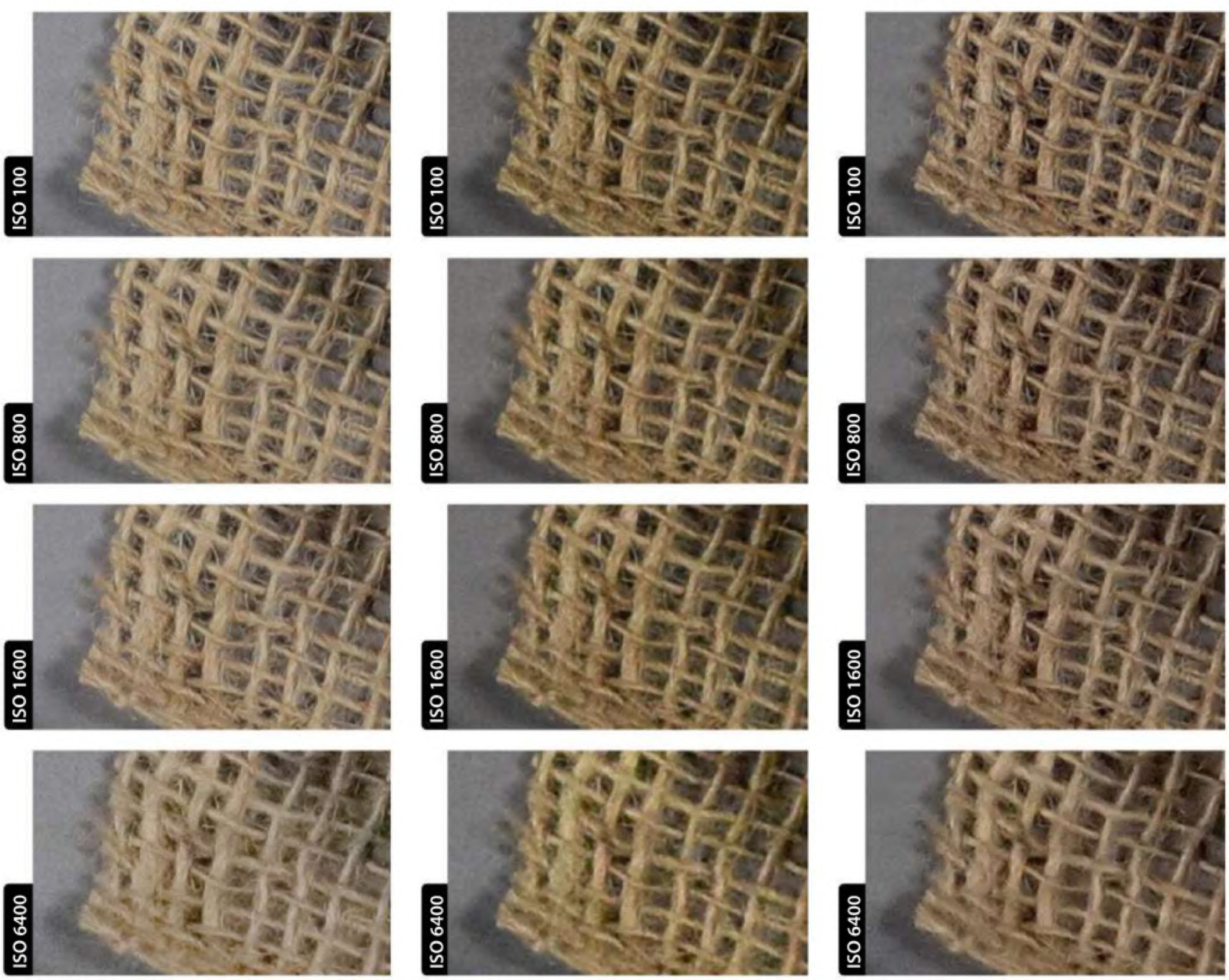
The Sony offers mini HDMI and micro USB 2.0 connectors, and flash or a cable remote release are attached via the 'multi interface' accessory shoe. The Nikon and the Canon have built-in USB 3.0 connectors for fast data transfer.

The two DSLRs have similar controls, and all major functions have dedicated buttons or dials, many of which can be customized to cover a range of functions. The smaller size of the Sony's body means it has fewer controls arranged quite differently from those in the other two cameras, although they are still highly customizable. The Sony system is relatively simple to learn and many options are selected via the menu system, which is also customizable.

Sony a7R

The mirrorless Sony scores highly with its compact size and clever details

Test Results and Image Quality: ISO Comparison



Our lab-based visual noise test saw all three cameras recording very good values of 1.1 (Sony) and 1.3 (Canon and Nikon) at ISO 100, increasing to highly respectable values of less than 2 at ISO 400. At ISO 1600, things begin to drift, with the Canon recording a value of more than 2, the Nikon just under 2 and the Sony way ahead with an excellent reading of 1.4. The same trend continues at ISO 6400, with the Sony still recording less than 2, ahead of the Nikon's 2.5 and the Canon's 3.8.

In contrast, the JPEG shots of our studio test scene put our lab-based results into perspective (our original JPEG and RAW test images are included with this issue's online content). In spite of more obvious noise in monotone details of a 100% enlargement at ISO 6400, the EOS 5Ds R reproduced the finer details in our scene very nicely indeed. The D810 produced similar detail quality, although the images are quite obviously sharpened and consequently have less visible noise. The same effect is even more evident in the Sony images, with virtually no visible noises in evenly-colored areas. However, even the Sony's algorithms can't hide noise in transitions such as the one between the background and our artist's palette, where detail is quite rough. The woodgrain shows alternate smoothed and oversharpened details, producing a less natural overall look than the Canon.

Resolution

We developed our raw test images in Lightroom using the Noise Reduction tool. We then transferred our settings to our opto-electronic conversion functions (OECF) charts and put the results through our custom analysis software. Tested this way, the Canon recorded a visual noise value of 4.0 compared with the 3.5 recorded by the Sony and the Nikon (all results at ISO 6400).

In the resolution stakes, the Canon won the day, recording 2670 line pairs of center resolution at ISO 100 and f8. Using the same parameters, the Nikon recorded 2450 line pairs and the Sony 2200. These values were reflected in our studio test shots, especially in enlarged details. The EOS produces visibly better detail rendition, although all three quickly lose resolution at higher ISO values. In spite of more visible noise, the Canon still produced 2380 line pairs of resolution at ISO 6400, which is about 300 line pairs more than both other cameras. The Canon also produced the fewest obvious moirés in our test scene.

Studio Results

Portrait and general people photography are the disciplines in which these megapixel monsters really shine. We tested all three in the studio using an 85mm f/1.4 Zeiss Otus. Such high sensor resolution presents the photogrpaher with signficant challenges, even in a controlled studio environment. It is quite difficult to focus precisely on a specfiic detail such as our subject's eye, even using a tripod. We selected the left eye in the Nikon detail because it was slightly sharper than the right, although the difference was hardly detectable on the camera monitor, even at its highest zoom setting. In spite of these misgivinigs, all three cameras proved to be excellent studio tools that fulfill professional demands in portrait and product photography situations. Here too, the Canon produced details and fine textures that were noticeably sharper than those from the other two cameras.

Canon EOS 5Ds R 300 %

Nikon D810 300 %

Sony a7R 300 %

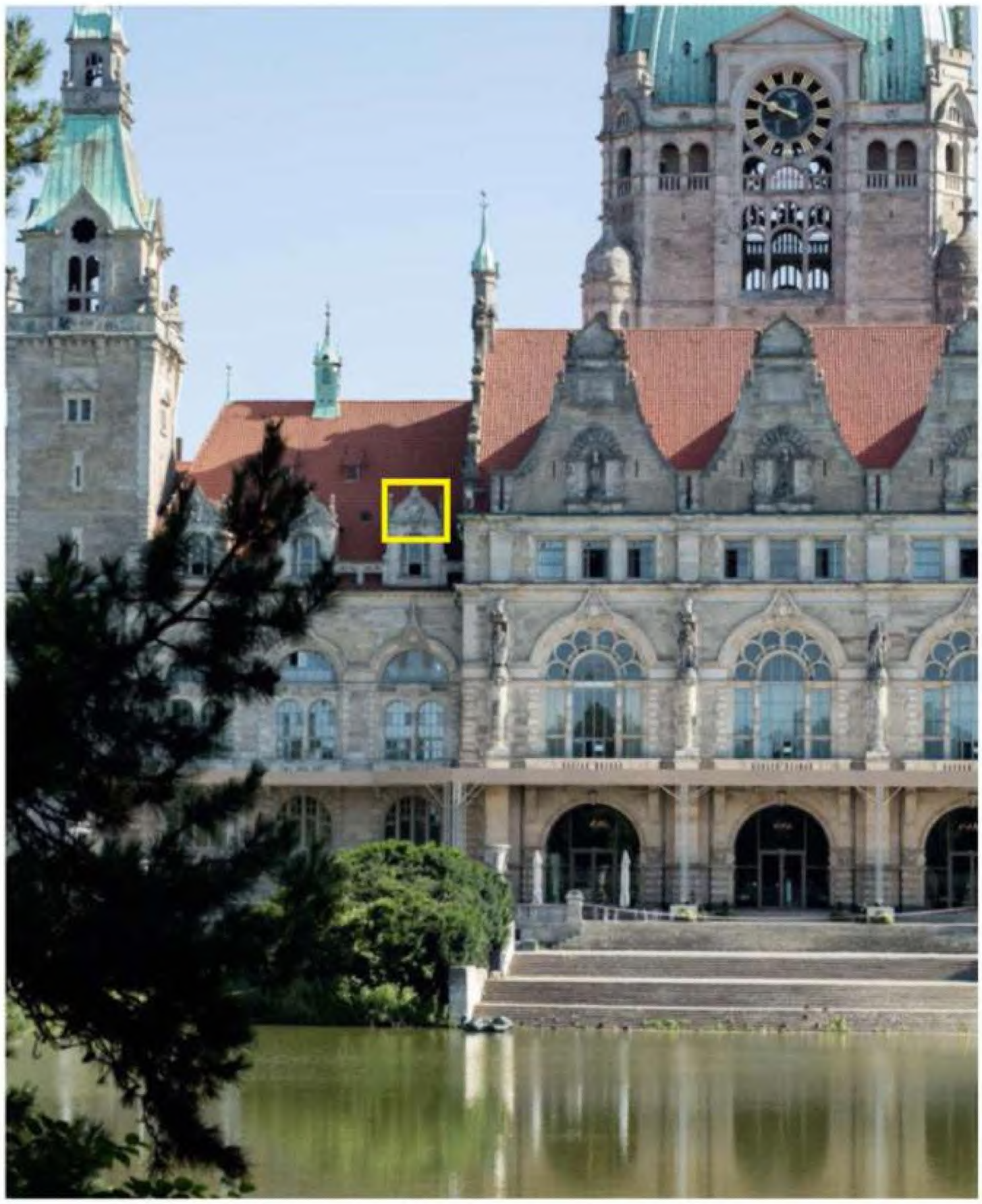
Conclusions

Regardless of their absolute sensor resolution, all three test cameras delivered astonishing levels of detail and impressive overall image rendition. However, if you are considering purchasing a multi-megapixel camera, you need to consider carefully in advance how you actually intend to use it.

There is no real point in shooting 50-megapixel images if you use them to make A4 or A3 prints. However, if you shoot landscapes, architectural subjects or fashion for poster-size or fine-art prints, you are sure to benefit from the editing options that such high pixel densities offer.

The results we produced here and those in the dedicated lens test that follows show just how important your choice of lens is when shooting with such a demanding camera. It isn't always the most expensive lens that produces the best results, but rather the most well-chosen.

In a direct, subjective comparison, the EOS 5Ds R noses ahead of the competition in the resolution and detail rendition stakes, and the apparently high noise values it recorded in the lab are less significant when shooting raw in the field. The Nikon D810 and Sony a7R achieve lower JPEG noise ratings at the cost of additional artifacts. The images from all three respond well to noise reduction at the raw development stage. We can hardly wait to see how the Sony a7R II performs and we promise to let you know what we find. (pen) c't



Architecture

The 85mm Zeiss Otus isn't an ideal architectural lens, but nevertheless proved highly capable when capturing our outdoor test shots. The details reproduced here come from images captured at ISO 800 so you can see for yourself how each camera's internal noise reduction affects detail rendition. We developed the images identically in Lightroom and, once again, the EOS 5Ds R came up with the best detail sharpness in spite of its slightly more obvious noise.

Canon EOS 5Ds R 840 %

Nikon D810 840 %

Sony a7R 840 %

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Sophia Zimmermann

Ready for 50 megapixels and more

EOS 5Ds R Lens Test

Medium-format resolution in a full-frame sensor sounds tempting, but is it really possible to shoot genuinely sharp images at this kind of pixel density? The bottleneck in this case is bound to be the lens, so to find out what's possible and what's not, we got hold of a bunch of standard Canon lenses and a couple of exotic alternatives and put them through their paces with the EOS 5Ds R.

Test Lens Overview

Technical Data

	EF 11-24 mm f/4L USM	EF 14 mm f/2.8L II USM	EF 24-70 mm f/4L IS USM	EF 24-105 mm f/4L IS USM
Current price	$3,000	$2,100	$1,000	$1,000
Max. aperture / Number of blades	f/4- f/22 / 9	f/2.8- f/22 / 6	f/4- f/22 / 9	f/4- f/22 / 8
Close-fcous distance	0.28 m	0.2 m	0.38 m	0.45 m
Length / Weight	5.2" (132 mm) / 2.6 lb (1180)g	3.7" (94 mm) / 1.42 lb (645 g)	3.66" (93 mm) / 1.32 lb (600 g)	4.2" (107 mm) / 1.47 lb (670 g)
Test Results				
Short end center/edge resolution at f/5.6[1]	2734 / 2142	2728 / 2039	2597 / 2346 Lp/Bh)	2724 / 2033
Long end center/edge resolution at f/5.6[1]	2664 / 2000	–	2458 / 1774	2358 / 1736
Distortion at max. aperture (w-a/t)	2.2 % / 0.1 %	-0.90 %	-1.3 % / 0.21 %	-1.8 % / 0.5 %
Chromatic aberration at max. aperture[2] (w-a/t)	0.27/ 0.44	0.52	0.46 / 0.5	0.62 / 1.17
AF shutter lag (w-a/t)	0.41 s / 0.58 seconds	0.53 s	0.45 s / 0.57 s	0.63 s / 0.58 s

[1] In line pairs [2]in pixels w-a/t = wide-angle/telephoto – = not applicable

Canon's 50-megapixel 5Ds models take the sensor resolution race to the next level and promise more detail and better rendition than ever before. However, to get the best out of the new sensor, you have to shoot extremely carefully, as we pointed out in the previous article (see page 20). But it's not only the photographer who faces a challenge – the lens you choose also has to be up to the job of utilizing all that resolution to the full.

Canon has, in fact, released a list of lenses it recommends for use with the EOS 5Ds models. Perhaps surprisingly, the $1,500 EF 16-35mm f/2.8L II USM and the EF 24-105mm f/4L IS USM kit lens aren't on the list, which equates to an official warning that they might produce poor results. For other old favorites, including the EF 14 mm f/2.8L II USM and the EF 70-200mm f/4L USM, Canon recommends careful, individual post-processing.

We found all this a little bewildering, so we decided to find out for ourselves how a selection of Canon lenses perform with the 5Ds. These range from extreme wide-angle to telephoto and include fixed-focal-length primes as well as zooms.

We made our usual exhaustive lab tests and took the lenses out to the Berggarten botanical garden in Hannover on a calm sunny day to capture some real-world test landscapes. We rounded out our test by shooting some portraits using most of the lenses mentioned plus the EF 100mm f/2.8L Macro IS USM. We couldn't possibly reproduce all these photos in the magazine, so we have included a selection of our original test files with this issue's online content.

	EF 35 mm f/1.4L USM	EF 50 mm f/1.8 STM	EF 70-200 mm f/2.8L IS II USM	EF 70-200 mm f/4L IS USM	EF 100 mm f/2.8L Macro IS UMS
	$1,480	$125	$2,000	$1,149	$899
	f/1.4-f/22 / 8	f/1.8-f/22 / 7	f/2.8-f/32 / 8	f/4-f/32 / 8	f/2.8-f/22 / 9
	0.3 m	0.35 m	1.2 m	1.2 m	0.3 m
	3.4" (86 mm) / 20.46 oz (580 g)	1.6" (40 mm) / 5.7 oz (160 g)	7.8" (199 mm) / 3.28 lb (1490 g)	6.8" (172 mm) / 1.67 lb (760g)	4.84" (123 mm) / 1.38 lb (625 g)
	2705 / 2216	2355 / 2623	2608 / 2359	2582 / 2018	2670 / 2221
	–	–	2518 / 2095	2429 / 1793	–
	-0.50 %	-0.30 %	-4 % / 0.4 %	-0.4 % / 0.5 %	0 %
	0.99	0.18	0.27/ 0.28	0.48/ 0.52	0.5
	0.48 s	1.14 s	0.6 s / 0.55 s	0.57 s / 0.5 s	0.66 s

Wide-angles

Our wide-angle test lenses offer a range of focal lengths and exciting perspectives and have 'interesting' prices to match. The 14mm lens currently costs around $2,100 – almost a bargain compared to the $3,000 EF 11-24mm zoom, which is also extremely big and heavy. It measures 4.3×5.2 inches and weighs 2.6 lb, giving it a more imposing look even than the EF 70-200mm f/2.8L IS II USM telephoto zoom.

EF 11-24mm f/4L USM

This lens is extremely robust and its build quality is impeccable. Movement in the manual focus ring is pleasantly firm and makes precise focusing a breeze. The mode switch on the lens is easy to reach and autofocus is fast and reliable – we measured just 0.0415 seconds of shutter lag in the lab.

The lens performed impressively too. It produced its best results in the lab at short and mid-range focal lengths, recording almost 96 percent center resolution with an excellent reading of 2770 line pairs (out of a theoretical 2896) wide open at 14mm. Edge resolution of 2205 line pairs is good but not quite as impressive. Performance in general wasn't quite as good at the long end, although the lens still managed to resolve more than 2600 line pairs between f4 and f8. Edge performance at the long end was obviously weaker, but chromatic aberrations and other artifacts remained modest throughout the range.

At these kinds of focal lengths, you have to see distortion as a compositional tool rather than a lens error, athough at more than 2 per cent, there is quite a lot of it around. Center sharpness and contrast are excellent, and give images a highly three-dimensional look. Only the obvious fringing artifacts in the corners require a little post-processing, and they all but disappear at longer focal lengths anyway. The differences in performance throughout the zoom range were extremely mild in our lab tests, although keen pixel peepers will detect slightly more microcontrast at the short end and a slightly softer look at 24mm.

EF 14 mm f/2.8L II USM

The 14mm prime wasn't quite as good as the zoom, showing obviously weaker edge performance. Its best result was a reading of 2752 line pairs at f4, which is comparable to that of the more expensive zoom. Edge resolution came in at 2077 line pairs all the way up to f11, while distortion and chromatic aberrations were generally more obvious than they were in the zoom.

The EOS 5Ds R and the EF 11-24mm f/4 look great together but weigh almost four pounds!

At first glance, the differences between the photos produced by the two lenses aren't that obvious, although the prime does produce a slightly cooler look. In our outdoor test shots, the prime shows a more obvious lack of definition at the edges of the frame, giving the corners a softer, more diffuse feel. We also noticed some slightly blown-out highlights. However, these imperfections weren't in evidence when we tested the lens on the lower-resolution EOS 5D Mark III. This particular combo produced excellent center sharpness and clean edges, with very good detail rendition, even at maximum aperture.

Our wide-angle test shots showed fairly extreme fringing effects that we were able to effectively counteract in *Lightroom*

The Bottom Line:

Neither of these lenses can be classed as an all-rounder, and both are at their best in landscape and architectural situations where stationary subjects with plenty of fine details are the order of the day. This makes them ideal for use with the EOS 5Ds R, which works best on a tripod and shows its real strengths with non-moving subjects. Both lenses performed well on the high-resolution camera, although the zoom produced better results at the edges of the frame. The weaknesses shown by the 14mm prime are more obvious in conjunction with the 50-megapixel sensor in the 5Ds than they are with the lower-resolution EOS 5D Mark III.

EF 11-24mm | 11 mm | f8 | 700%

EF 11-24mm | 14 mm | f8 | 700%

EF 14mm | f8 | 700%

EF 11-24mm | 24 mm | f8 | 400%

EF 11-24mm | 11 mm | f8 | 700%

EF 11-24mm | 14 mm | f8 | 700%

EF 14 mm | f8 | 700%

EF 11-24 mm | 24 mm | f8 | 400%

Standard Primes and Zooms

While most people will only pack a wide-angle lens for certain specific jobs, the lenses covered in this section are part of many a standard kit.

The EF 35mm f/1.4L USM is obviously aimed at the pro sector and has a price tag of $1,480 to prove it. In contrast, the latest low budget EF 50mm f/1.8 STM Canon lens costs just $125 and, not surprisingly, is made largely of plastic. Build quality matches its price and it is difficult to achieve precise results with its narrow manual focus ring. The 35mm lens is a lot heavier and easier to handle although it, too, has plenty of plastic components.

EF 35mm f/1.4L USM

At maximum aperture, we recorded 89% center resolution, or 2575 line pairs. This excellent result was marred by edge weakness that is quite obvious in our test images and takes the form of soft, burned-out textures. Generally, images shot wide open lack microcontrast throughout the frame.

Two stops down, things look much better, with much less vignetting, better edge sharpness, better center contrast and a more balanced look. Our lab test results mirror these observations, with maximum center resolution of 2700 line pairs between f4 and f5.6 and edge resolution of 2366 line pairs at f8, where it is no longer possible to tell the difference between the center and the edges with the naked eye.

It recorded a respectable distortion value of -0.5, and the relatively high chromatic aberration value of almost one whole pixel hardly detracts from the overall look of the images.

EF 50mm f/1.8 STM

This lens was a real surprise, producing excellent lab test values that, in view of its low price, were out of step with our expectations. The lens hit the market at almost the same time as the EOS 5Ds, so it is quite possible that it is optimized for use with the new camera. It performs particularly well at the edges of the frame, recording more than 2000 line pairs at f2.0 and increasing to more than 2600 at f5.6. Overall, it produced extremely balanced results.

Out in the real world, the 50mm can't quite match the center resolution of the 35mm lens but isn't as soft at the edges. Stopped down performance is great, with very good detail rendition of even the finest textures in the fern fronds we captured. Generally, edge performance is better than that of the 35mm, with virtually no fringing and a negligible distortion reading of -0.3%.

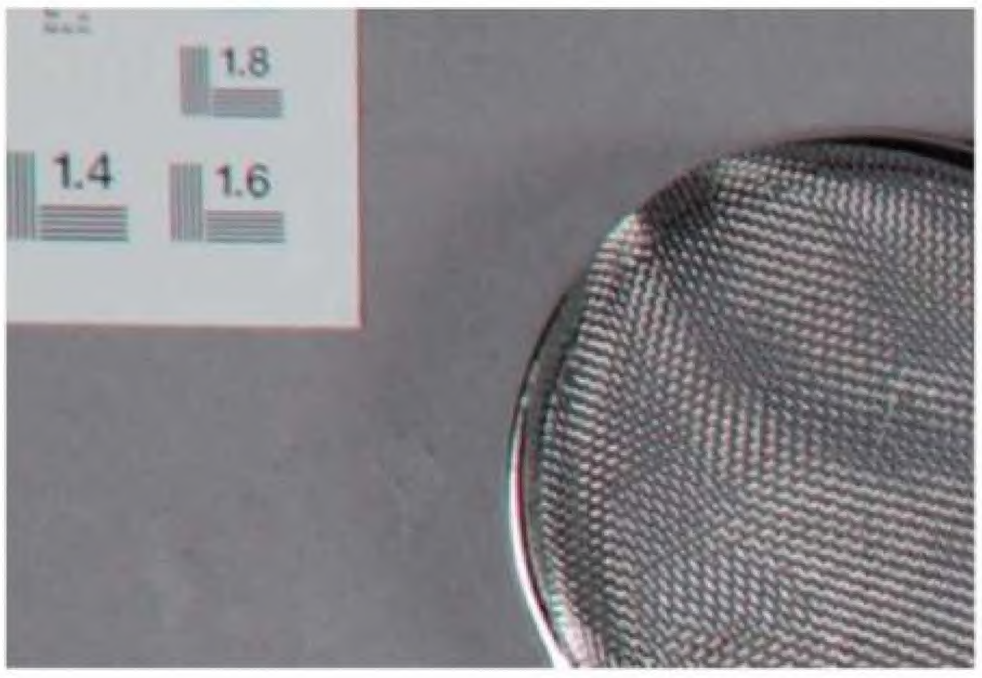
EF 24-70mm f/4L and 24-105mm f/4L

The 24-105mm zoom is the standard kit lens supplied with the EOS 5D Mark III, while the EF 24-70mm f/4L IS USM covers one of the most popular ranges of focal lengths around.

Both lenses are 'L' models that are dust and moisture protected. Both have aspherical and UD (Ultra-low Dispersion) elements for combating distortion and color errors, and both have built-in stabilizers and ultrasonic motors. They also have the same maximum aperture of f/4.0 throughout the zoom range.

The similarities don't stop at the specifications and are partially mirrored in our lab test results too. Wide-angle performance is similar in both lenses. The 24-70mm recorded 2530 and the 24-105mm 2670 line pairs. In both cases, edge resolution came in relatively poor at below 2000 line pairs and produced visible weakness in our test shots. Overall, the 24-70mm lens has less fringing issues. The 24-70mm performed better stopped down too, and showed less image quality falloff beyond f8.

At medium apertures, these roles are reversed, with the 24-105mm breaking the 200 line pairs mark at the edge of the frame at f4.0. The 24-70mm only manages the same at f8. Neither lens excels at the long end, and the 24-105mm shows an obvious blue cast and some burned-out details, resulting in a slightly softer overall look.



The 24-105mm zoom is one of Canon's standard kit lenses. It shows obvious softness at the edges of the frame but very good center performance at 105mm.

The Bottom Line

Don't be afraid to lower the bar! The $125 50mm STM lens may be cheap but is still equal to the challenges presented by the EOS 5Ds R, as is its more expensive 35mm sibling. Whichever lens you choose, you need to stop down if maximum sharpness is of the essence. The 'standard zooms' we tested performed well enough, but produced varying (but still obvious) edge weakness at a range of focal lengths. Using these lenses with the EOS 5Ds R means taking special care with composition and will probably require some post-processing too.

Captured using the EF 50mm f/1.8 STM in the Berggarten botanical garden in Hannover

EF 35mm | f8 | 600%

EF 50mm | f8 | 390%

EF 24-70mm | 50 mm | f8 | 390%

EF 24-105mm | 50 mm | f8 | 390%

EF 35mm | f8 | 600%

EF 50mm | f8 | 390%

EF 24-70mm | 50 mm | f8 | 390%

EF 24-105mm | 50 mm | f8 | 390%

Telephotos

Following directly on from our standard lenses, our choice of telephotos includes the f/4L and f/2.8L IS USM 70-200mm zooms as well as the more exotic EF 100mm f/2.8L Macro IS USM.

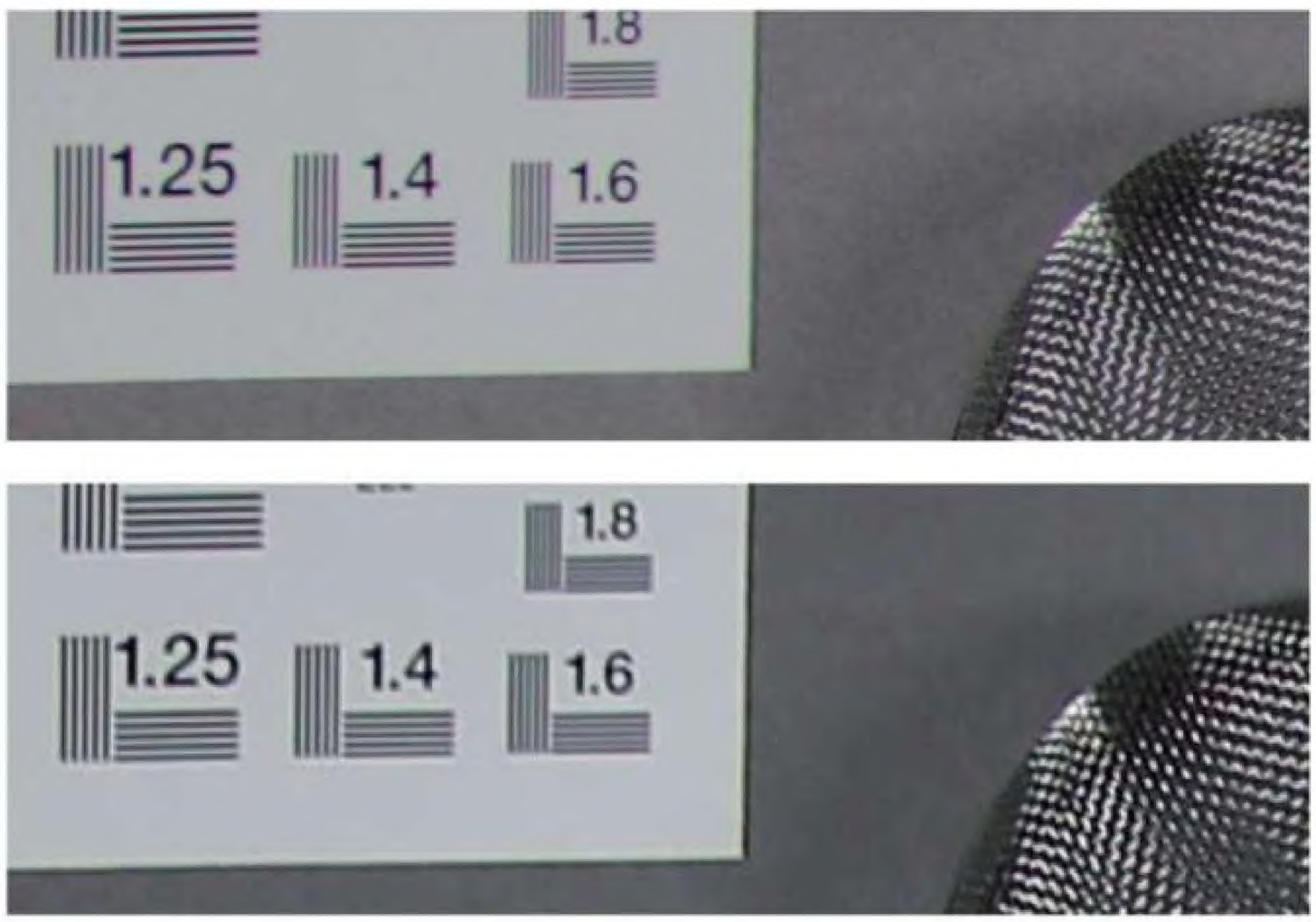
Macro photography with the EOS 5Ds R is a real challenge, and even the tiniest movements reduce overall sharpness

Mid-range Value vs. Fast and Expensive

The two EF 70-200mm zooms cover the same range of focal lengths but have different maximum apertures. At $2,000, the newer Mark II version of the f/2.8 zoom costs almost twice as much as its f/4 counterpart and tips the scales at 3.28 lb, compared with 1.67 lb for the cheaper model. Both lenses belong to the white-barrel 'L' family and are dust and water protected. Their focus and zoom rings are smooth and precise.

As expected, the more expensive model performs better throughout the aperture and zoom ranges (see our telephoto zoom test in issue 21 for more details). Wide open, the f/2.8 lens produced 2621 line pairs of center resolution at its short end and a respectable reading of 2220 line pairs at the edges. Performance remains stable up to around the 100mm mark but weakens a little toward the long end. A comparison test with the same lens mounted on the EOS 5D Mark III produced just 1465 line pairs at 70mm – a major difference that is clearly visible in our test images (included with this issue's online content).

The f/4 version's performance lagged behind at short and medium focal lengths, showing more obvious vignetting at maximum aperture. Fine details too, are softer at the edges and show more fringing artifacts. In the detail rendition stakes, the more expensive lens wins the day too, with better center resolution and much better detail contrast at f4 and beyond. All of these differences are less pronounced at the long end of the zoom range.



Most of our test lenses were able to produce adequate center sharpness with the EOS 5Ds R but lacked resolving power at the edges of the frame. Even the high-end 70-200mm f/2.8 zoom produces some fringing artifacts (top) that weren't visible when we tested the same lens with the EOS 5D mark III (bottom).

EF 100 mm f/2.8L Macro IS USM

Our macro contender matches the image quality of the f/2.8 zoom, producing 2620 line pairs of center resolution at f2.8 and a moderate decline to 2020 line pairs at the edges of the frame. Edge resolution improves to 2370 line pairs at f8, while center resolution at f4 measures 2700. Overall, it is one of the better lenses we tested this time around.

It produced excellent center sharpnes in our outdoor test shots and good detail contrast, but didn't quite match the image quality of the f/2.8 zoom overall wide open at 100mm. It showed slightly more vignetting but just as little fringing. Here too, stopping down improves overall sharpness a great deal.

The Bottom Line

In portrait, landscape and macro image situations, these lenses confirm the long-held opinion that expensive lenses produce better results. Although the f/2.8 zoom performed well overall with the EOS 5Ds R, its edge performance let it down and the images it produced required more post-processing than those produced by the faster lens. The 100mm f/2.8 is a solid all-around portrait and macro lens and, at around $900, is easier on the wallet than the f/2.8 zoom. (ssi)

EOS 5Ds R with the Canon EF 100mm Macro | f4 | 300 %

EOS 5Ds R with the 85mm f/1.8 Zeiss Otus | f4 | 300 %

The EF 100mm f/2.8L Macro makes a great portrait lens, producing results comparable to those from the 85mm f/1.8 Zeiss Otus c't

Sophia Zimmermann

Leica M Monochrom

A unique camera with a charm all its own

Leica turned a few heads when it introduced the original black-and-white 'M' and the idea was so popular that the company has now introduced the new Typ 246 model. This article takes a look at the unique images this strange beast produces and compares its performance with other, more conventional system cameras in the lab.

The Leica M Monochrom Typ 246 cannot see in color. It has clear microfilters mounted in front of its sensor instead of the red, green and blue ones used in conventional cameras. Although this sounds like an old-school idea it has the distinct advantage of recording 'real' brightness values rather than the filtered ones a conventional RGB sensor produces. This means that the brightness values for the pixels in the resulting image don't have to be interpolated and the sensor can capture images at the full nominal resolution of the sensor, producing excellent detail rendition and sharpness. This approach also increases the sensor's sensitivity, and the Typ 246's range begins at ISO 320 rather than the ISO 100 value common to most digital cameras. All this high-end engineering has its price, and the Typ 246 retails for around $7,500 (for the body only). You will have to decide for yourself whether purchasing one is a sign of genius or madness.

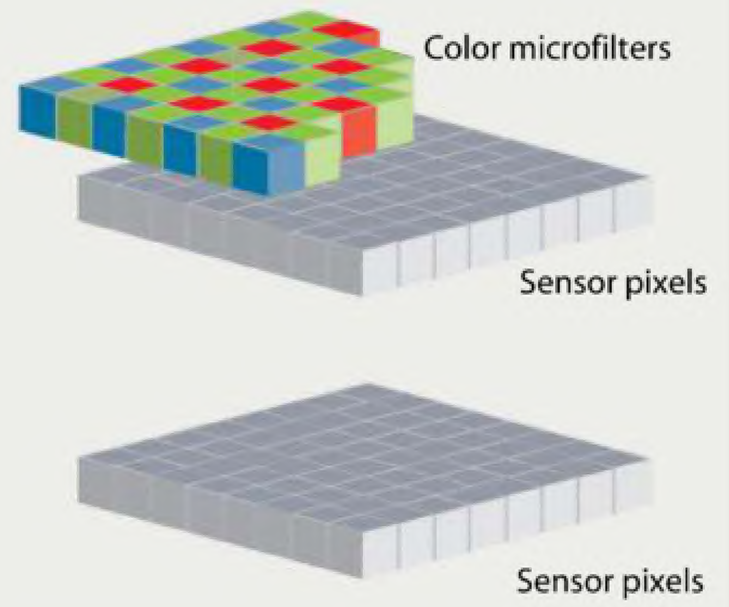
Leica is obviously convinced that the concept has a future and has been producing high-end monochrome digital cameras since the introduction of the M9 Monochrom in 2012. The newer camera has a 24-megapixel sensor instead of the 18-megapixel one built into the original Monochrom and the tiny monitor has been replaced with a 3-inch model, although its 921, 600 dots still can't really compete with the resolution offered by the monitors used by other manufacturers. The new monitor's benefits include live view and focus peaking displays. See the table opposite for more technical details.

Camera Body

The Leica is no slimline prima donna and is extremely robust. Its body is made of magesium alloy with brass top and botton plates, and the monitor is covered with a sheet of scratchproof sapphire crystal.

Color vs. Monochrome Sensor

The sensor in the Leica M Monochrom Typ 246 has no RGB microfilter array like a conventional color sensor. This means that the sensor delivers non-filtered brightness values for each pixel and creates true black-and-white images with greater resolution and dynamic range than it is possible to produce using a conventional sensor with the same number of pixels.



Handling

The Typ 246 uses the same chassis as the current Leica M Typ 240, which is aimed at photo purists with a penchant for manual exposure control and no need for over-the-top effects. The body has a smooth, clean design and its brass top and bottom plates make it quite heavy. The thin leather covering around the center of the body is the only thing that counteracts the smoothness of the metal and there is no grip of any sort. Leica seems to pay no heed to ergonomic considerations.

There is no mode dial, and the top plate houses only the exposure time dial (with its 'A' auto setting), the shutter button, the flash shoe and the main switch, which turns the camera on and off and enables you to select single, continuous or self-timer shooting modes. The aperture is set using the ring built into the lens and the ISO value is regulated using the dedicated button on the camera back. Exposure compensation can be set either via the menu system or using the focus button (on the front next to the lens) and the 'thumbwheel' as Leica calls it, which is located on the camera back.

Leica users usually compose their images in the viewfinder and focus manually, but the Typ 246 offers a live view that also displays the major shooting parameters by default. You can use the INFO button to add an electronic level and a battery level indicator. There is, however, no grid display, which is a serious deficit in a high-end camera designed for manual use.

However, focusing using the monitor is extremely precise and is aided by the zoom function that automatically kicks in when you move the focus ring on the lens or press the focus button. Unfortunately, the zoomed detail cannot be shifted the way it can in most DSLRs and mirrorless system cameras. The focus peaking function highlights in-focus details in color and is a great aid to manual focusing. All in all, using the built-in electronic focusing aids is faster than using the split-image viewfinder.

Swapping memory cards is quite tricky, as the only slot is concealed beneath the bottom plate, which has to be completely removed to insert the card (or the battery), so make sure you use a card with sufficient capacity if you are using the camera on a tripod. As long as you don't use live view too much, a single charge of the battery should last for most sessions.

Apart from the flash shoe, the only connectors on offer are for an electronic viewfinder and a microphone. The contacts for the optional multi-function grip are also located beneath the bottom plate next to the memory card slot.

Leica M Monochrom Typ 246

Technical Data	
Sensor resolution	5976 × 3992 pixels
Megapixels	24
Sensor size	Full-frame (23.9 × 35.8 mm), no low pass filter, no color filter (CMOS)
Crop factor	1
Raw capture	✓ (compressed or uncompressed)
Autofocus type	–
Shortest / Longest exposure time	1/4000 s / 60 s
Sensitivity	ISO 320-25 000
Viewfinder (coverage)	Bright frame rangefinder (100 %)
Monitor	LCD, 3"
Monitor resolution	921,600 dots
Monitor articulation	–
Dimensions (W/H/D)	139 × 80 × 42 mm (5.5 × 3.1 × 1.7")
Weight (incl. batt. and memory)	680 g (1.5 lb)
Memory card support	SD, SDHC, SDXC
Connectors	Flash shoe, accessory socket, contacts for multi-function grip
Power source	Li-Ion battery (7.4 V, 1800 mAh)
Price (body only)	$7,450
Test Results	
	better ▶
Sensor resolution (in line pairs)	1984
Center resolution (ISO 320)	1984
Center resolution (ISO 800)	1984
Center resolution (ISO 1600)	1984
Center resolution (ISO 6400)	1984
Dynamic range (ISO 320, f-stops)	10.28
Dynamic range (ISO 800, f-stops)	10.22
Dynamic range (ISO 1600, f-stops)	10.16
Dynamic range (ISO 6400, f-stops)	7.96
	◀ better
Visual Noise (ISO 320)	0.9
Visual Noise (ISO 800)	1.3
Visual Noise (ISO 1600)	1.8
Visual Noise (ISO 6400)	3.6

✓ included – not included

Clean Design

The camera's top plate houses only the main switch, the shutter button, the exposure time dial and the flash shoe

ISO 320

ISO 800

ISO 1600

ISO 3200

Increasing the ISO value makes virtually no difference to the results the Typ 246 produces. Images remain clear and detailed with a highly three-dimensional look all the way up to ISO 3200.

Test Results and Image Quality

As expected, the Typ 246 and the Summarit-M 35mm f/2.4 ASPH lens we used to test it delivered superb results in the the lab. At its lowest ISO value of 320 we recorded a visual noise value of just 0.9, which is very close to our 0.8 reference value that indicates practically noise-free performance. Values up to 2.0 indicate mild noise, up to 3.0 obvious noise, while values above 3.0 indicate severe, disruptive noise. At ISO 800, the value increased to 1.3 and broke the 2.0 mark at ISO 3200. We measured a value of 3.6 at ISO 6400. In the resolution stakes, the Typ 246 recorded 1984 line pairs of resolution (i.e., 100%) throughout the frame at ISO 320 and the reading didn't budge all the way up to ISO 6400.

In our real-world test shots we were unable to see any significant differences between images captured at ISO 320 and 1600. All details remained clear and sharp, and all of the textures remained precisely rendered.

JPEGs are processed extremely tentatively, and the raw files produced by the Typ 246 offer enormous processing potential. They simply don't soften up, even when subjected to extreme sharpening and you really can squeeze every last drop of microcontrast out of them. The tiniest pores and threads in our test images usually remain unresolved in our camera tests, but the Leica captured them all in great detail. For landscape images, the Monochrom is in a class of its own and the fine grain structures that appear at high ISO values still don't obscure any relevant subject detail.

Conclusions

The Leica is an exotic device for special applications. It is perfect for relaxed shooting on a calm day, or perhaps something to aim for when you retire, but is too heavy, complicated and inflexible for everyday photographic use. Its lack of basic features such as autofocus or a battery grip make it a niche product at best, and its concentration on black and white make it unsuitable for capturing happy-go-lucky snapshots on the fly.

Monochrome fans are sure to love its unique brand of 'automatic melancholy', but the Leica approach simply isn't destined for the mainstream.

On the other hand, the 'lady in black' is sublimely immune to criticism when it comes to build and image quality. (ssi)

Leica M9 Monochrom at ISO 6400

Leica M Monochrom Typ 246 at ISO 6400

The new sensor in the Leica M Monochrom Typ 246 has much better noise characteristics than its predecessors – details and textures are no longer swamped by the grain effect at high ISO values c't

Like this busy image that we shot at the Berggarten botanical garden in Hannover, even snapshots end up looking quite dramatic when they are captured using the Typ 246. The level of detail the Leica captures is astonishing, especially in the shadows.

Leica M Monochrom Typ 246 | 35 mm | ISO 320 | f4.8 | 1/1500 s

Peter Schuffelen

Behind the Scenes

High-end Car Shoot with René Staud

This Staud Studios shoot for Mercedes-Benz brought together a 544 horsepower off-road super-jeep, a 15-person team and a five-day production schedule, all shot against the spectacular background of a Namibian landscape. In this article, visionary automotive photographer René Staud describes the logistical, technical and creative challenges involved in this fascinating project.

Walvis Bay, Namibia. The silver metallic Mercedes G63 AMG 6×6 is a six-wheeled all-terrain vehicle that weighs almost four tons, is nearly seven feet wide and houses 544 horsepower under its bonnet. This monster is quite at home battling its way through sand or accelerating up to 180 km/h (111 mph) through the flat Namibian desert. Thrown into a curve by Mercedes' chief test driver, the G63 produces 10-foot plumes of flying sand that look like the spray kicked up by a speedboat. If desert travel at highway speeds sounds far-fetched, check out the film produced to promote this $600,000 G-class special (https://vimeo.com/62088444). Slow-motion, color grading and a host of other post-production techniques give the video a unique high-end look, although René Staud, founder of Staud Studios, assures us that the footage was all shot in real time and that adding clouds of sand during post-production would involve too much effort to be cost-effective.

Shooting in the desert with an Alpa medium-format camera and a Leaf Aptus-II 12 Digital back

Guaranteed Perfect Weather

The stills produced during the five-day video shoot are no less impressive. For example, the 54-degree granite rockface that the G63 negotiated with ease at Vogelfederberg is

The logistics of the shoot involved flying the car to Africa and hauling it to the various locations on a truck

The Shoot

The Brief: Advertising images of the Mercedes G63 AMG 6x6 off-roader

Photography and post-production: Uwe Kristandt

Concept and art direction: René Staud

Location: Namibia

René Staud

René Staud came to fame with his own patented Magic Flash system of ultra-large-scale lightboxes that enable him to photograph cars as if they were pieces of jewelry on a light table. He shoots for famous auto-makers all over the world, including Porsche, Mercedes-Benz and Aston Martin. Staud Studios near Stuttgart, Germany employ 35 photography, film and CGI experts.

The setup at Vogelfederberg in the Walvis Bay area of Namibia. The studio flash on the left gives the car's bodywork extra depth in the resulting stills.

impossible to negotiate in normal shoes. Staud, who was responsible for the overall strategic concept for the project says Namibia was the ideal location for this shoot. "The weather is always great and nowhere on Earth offers such a variety of landscapes in such a relatively small area." Even if the photos and footage the team captured present a thoroughly untamed product, the shoot itself was highly organized and timed right down to the last second. The 15-strong team included the photographer, the director, the driver, octocopter pilots, local production assistants, mechanics and, of course, the client. By Staud standards, this is a small team. Some productions see as many as 50 or even 100 people on set. They worked 18 hours a day, although the midday sun was so intense they could only use it to shoot video, not stills.

The gear used on the shoot matched the larger-than-life subject. Video was captured using a 4K-capable Sony NEX-FS700UK camcorder and two full-frame Red EPIC movie cameras, which were mounted on a drone for some of the overhead shots. The stills were captured using a medium-format Alpa body that Staud describes as "an ultra-minimalist and extremely flexible photographic tool that is compatible with just about any lens and digital back." For this shoot, the Alpa was fitted with 28 and 35mm Rodenstock APO-Sironar Digital HR lenses and an 80-megapixel Leaf Aptus-II 12 Back – one of the highest-resolution backs currently available. The brief for the shoot at the Spitzkoppe Conservation Area was to capture images for a range of usage scenarios – from posters through supersized illuminated signage to catalog and brochure shots, all

Loosening up during a break in the action. The 15-strong team worked 18 hours a day shooting a promotional video and the stills reproduced on these pages.

The four-ton G63 6x6 was photographed in a variety of locations – here on a 54-degree granite rockface

The brief for the shoot was to produce stills for a wide range of formats – from large-scale posters to catalogs and web-based images

The Mercedes G63 AMG 6x6 in action. The pan effect was added during post-production.

with sufficient 'space' for any cropping that might be required.

Modeled using Artificial Light

The stills were lit using a rugged Broncolor Primo studio flash setup capable of withstanding temperatures of up to 35 degrees Celsius (95 Fahrenheit) in the shade. To portray the technical perfection of the subject with an authentic but highly three-dimensional look, the team shot using reflected ambient light but used flash to light the body of the car. Staud says his team always underexposes location shots by one or two stops to prevent the landscape from becoming overlit.

During post-production in Germany, the car's bodywork was cleaned up and given some extra kick, the backgrounds were tidied up and contrast and colors were intensified and harmonized.

In total, the project involved 15 people, five weeks of planning, five days on location and a four-ton vehicle that had to be air-freighted to the location. We wondered whether it might have been easier to capture the location using a 360-degree spherical-capture camera, render the car digitally and mount it on digital backplates with detailed location and lighting data. Staud doesn't think so: "Aesthetically speaking, CGI is always second best, so we only use it we can't carry out the shoot as planned, either because the location is impossible to reach or the vehicle isn't available. A CGI production often costs more than a conventional shoot anyway. In spite of location costs of around $80,000, a completely computer-generated shoot would have been more expensive still. Building authentic-looking special effects on a computer involves a lot of work. For example, simply creating a cloud of digital dust costs up to $6,000."

Tight schedules and shrinking budgets make life increasingly hard for professional automotive photographers, and Staud says the industry as a whole is stagnating. However, Staud Studios is in a position to offer the very highest quality and a wide range of services from a single source – from creative consulting through traditional stills photography to 3D rendering and high-quality video for Web or TV use. Working with a single studio shortens the decision-making processes involved in complex productions and helps to cement customer relationships.

Staud, 65, and his team work virtually all year round and are constantly faced with new logistical and technical challenges, which all sounds pretty exhausting. "Of course our line of work requires a lot of energy, but when we are on location for a production like the Namibia shoot, I always end up thinking how lucky I am to be able to do this job." (sea) **ct**


Distagon 2.8/15 ZF.2
FUJINON ASPHERICAL LENS
SUPER EBC XF 14mm 1:2.8 R Ø58

Thomas Hoffmann, Sophia Zimmermann

The Wonderful World of Wide-angle Lenses

Wide-angle lenses produce spectacularly detailed photos that give the viewer the feeling of being part of the scene. However, the range of available models is relatively narrow and their prices are often quite high. We tested a range of high-end wide-angle primes and pitted them against the cheaper third-party competition to see whether the significant price differential really is justified.

A Challenge for the Photographer and the Lens Designer

Using a wide-angle lens for the first time is something of a revelation, and most people are astonished at how close you can (and often must) get to the subject. However, reviewing the results on a monitor can be quite disappointing, as even the slightest tilt of the camera produces obviously converging lines, faces at the edges of the frame appear grotesquely distorted and poorly-thought-out compositions include too many irrelevant details that produce feelings of acute boredom in the viewer. The great depth of field also plays a role, as it captures details that would otherwise disappear into a pleasant blur when captured at the same aperture using a longer lens. The upside of the wide-angle effect is its ability to produce frame-filling shots of buildings and capture photos in small spaces. Even wildlife photographers make good use of this unusual perspective, as demonstrated by pro photographer Benny Rebel in our *Up Close and Personal* article in Issue 17.

Our Test Field

Most of our test lenses are full-frame models, and most of the APS-C lenses we looked at didn't reach our threshold equivalent focal length of 20 mm. One of the reasons for the lack of choice in this segment is the complicated nature of wide-angle lens design and construction. The mirror box in a DSLR is about 4 cm deep, making it necessary to use retrofocus designs to shift the focal point rearward. This increases the back focal length of the lens without altering its overall focal length. The result is an asymmetrical design with a large front element, which in turn makes automatic optical error correction more difficult. What all this boils down to are big, heavy lenses with price tags to match.

Pricing

Not surprisingly, the Zeiss Distagon T* 15mm f/2.8 ZF.2 for Nikon ($2,650), the Distagon T* 21mm f/2.8 ZE for ($1,800) and the Canon EF 14mm f/2.8L II USM ($2,000) are the most expensive lenses we tested. At these kinds of prices, you really need to be sure that wide-angle photography is up your street and that such expensive glass won't just end up gathering dust on a shelf. Nikon's fast AF-S 20mm f/1.8G ED has a mid-range price tag of around $800, the Sony 20mm f/2.8 around $750 and Canon's EF 20mm f/2.8 USM comes in quite a lot cheaper at around $500. At the bargain end of the range, the ultra-wide-angle Samyang 14mm f/2.8 for Nikon costs just $370 (the Canon version without a focus-confirm chip costs just $320), while the HD-Pentax-DA 15 mm f/4 ED AL Limited (for APS-C sensors) costs around $420 but has a much narrower maximum aperture than the rest. The Zeiss and Samyang lenses are manual focus only which, combined with such wide angles of view, presents a real focusing challenge that is easiest to master using live view.

As usual with our lens tests, we tested resolution using a chart made up of Siemens stars with sine wave-shaped brightness gradients. We also tested distortion and chromatic aberration using a chart made up of printer's register marks. We test vignetting using an Ulbricht integrating sphere. All tests are performed at maximum aperture and in one-stop increments. The shots we made of our studio test scene offer a good comparison to our lab test results and are included as full-resolution raw and JPEG versions with this issue's online content.

Our Test Cameras

We made our real-world test shots at the Berggarten botanical garden and the Lower Saxony state museum in Hannover. From the full-frame camp, we used Canon EOS 6D, Nikon D750 and Sony Alpha a99 camera bodies and a Pentax K-3 for the Pentax APS-C lens. We also captured comparison APS-C test shots using a Canon EOS 7D Mark II, a Nikon D7100 and a Sony a77II.

These three shots show the difference between the viewpoints captured by 105mm, 50mm and 15mm lenses. The wide-angle shot even includes the shadows of the tripod and the photographer.

Canon EF 14mm f/2.8L II USM

The lens: The 14mm Canon has a distinctively bulbous front element and a built-in lens hood to protect it. It is heavy and cool to the touch. The rubberized focus ring is easy to use and focuses precisely in manual mode. On our test lens, the rubber itself was already dirty and had begun to rub away in some places, which is perhaps a sign of poor quality in this particular component. Unlike in purely manual focus lenses, the focus ring can be rotated beyond its close focus and infinity settings.

Test results: Center resolution at maximum aperture measured 1634 line pairs and dropped off only moderately to 1367 at the edges of the frame. Center resolution increased to 1682 line pairs at f5.6 and edge resolution measured 1466 line pairs all the way up to f8. Vignetting came in at 2 stops at maximum aperture and distortion measured 0.7 per cent. Chromatic aberration measured 0.64 pixels. Things look better stopped down, with chromatic aberration decreasing to just 0.36 pixels and vignetting to 0.8 stops.

Image quality: At maximum aperture, the lens showed very good center resolution and detail rendition, but quality dropped off noticeably toward the edges of the frame, with soft details and obvious fringing at high-contrast edges. Overall, edge definition is poor. Using the lens stopped down is another story, with great definition that is equal to that produced by the 15mm Zeiss, albeit with some lens errors but very few visible fringing artifacts.

EF 14mm f/2.8L II USM	
Focal length	14 mm
Aperture range/ Number of blades	f2.8-22 / 6
Min. focus distance	0.20 m / 7.9"
Length / Weight	94 mm / 1.42 lb (645 g)
Price	$2,100
Lab Test Results	
Center resolution [1] (max. aperture/ +2)	1634 / 1683
Edge resolution [1] (max. aperture/ +2)	1367 / 1444
Chrom. aberration [2] (max. aperture/ +2)	0.64 / 0.36
Distortion	-0.7%
Vignetting [3] (max. aperture/ +2)	2 / 0.8
[1] in line pairs [2] in pixels [3] in f-stops	

Samyang 14mm f/2.8 IF ED UMC Aspherical

The lens: The large, rounded front element leaves no doubt as to the type of focal length this lens covers. The built-in lens hood makes using filters tricky, but its metal barrel, rubberized focus ring and heavy weight make it a pleasure to use. The focus ring offers a good degree of resistance and its unusally long travel makes precise manual focusing a breeze. Its internal focusing system means that its length doesn't change when you adjust focus. The plastic aperture ring has a firm movement and nice positive click stops.

Test results: Center resolution came in at an excellent 1830 line pairs at maximum aperture, but the edges offer only a poor 1301 line pairs. Stopping down increases center resolution a little, while the edges remain just as fuzzy. Vignetting came in at two stops at maximum aperture, decreasing to 0.9 stops at f5.6. Color rendition was very good throughout the aperture range and chromatic aberration of 0.12 and 0.16 pixels wide open and stopped down are highly respectable results. Distortion was quite obvious at 2.4 per cent.

Image quality: Vignetting was very obvious at maximum aperture in the studio, and distortion was difficult to overlook too. Center resolution is very good, but sharpness drops off significantly toward the edges of the frame, even in less detailed areas. Our test shots also mirrored lab performance at f5.6, with great center sharpness and contrast but poor edge performance in every respect.

14mm f/2.8 IF ED UMC Aspherical	
Focal length	14 mm
Aperture range/ Number of blades	f2.8-22 / 6
Min. focus distance	0.28 m/ 10.8"
Length / Weight	96 mm / 1.17 lb (530 g)
Price (Nikon / Canon)	$369 / $319
Lab Test Results	
Center resolution [1] (max. aperture/ +2)	1829 / 1877
Edge resolution [1] (max. aperture/ +2)	1301 / 1257
Chrom. aberration [2] (max. aperture/ +2)	0.16 / 0.12
Distortion	-2.4 %
Vignetting [3] (max. aperture/ +2)	2 / 0.9
[1] in line pairs [2] in pixels [3] in f-stops	

Zeiss Distagon T* 15mm f/2.8 ZF.2

The lens: Unsurprisingly, the Zeiss is the most expensive lens we tested and shows typically high build quality to go with its high-end price tag. The heavy lens is made entirely of metal, including the precisely machined focus ring. Great damping, perfect gearing and internal focusing make it simple to set focus at all apertures. For a fee of around $300, Zeiss will remove the built-in lens hood to reveal a 92mm filter thread.

Test results: Performance at maximum aperture is good but not stellar, measuring 1662 line pairs of resolution in the center and 1453 at the edges of the frame. Stopped down, center resolution increases to nearly 100% (1913 line pairs), although edge performance remains at its wide open level and only improves at f8 and beyond. The Zeiss engineers have done a great correction job, and neither chromatic aberration (0.1 pixels) nor distortion are visible in our test images. Vignetting came in at 1.5 stops wide open and 0.7 stops at f5.6. Both this and the 21mm f/2.8 Zeiss produced performance that was just as good when used with the APS-C Nikon D7100.

Image quality: Our test images have a highly three-dimensional look and great detail contrast right up to the edges of the frame. Only the corners show a slight dropoff in quality. Some vignetting is visible at maximum aperture, but there are no visible fringing artifacts at all.

Distagon T* 15mm f/2.8 ZF.2	
Focal length	15 mm
Aperture range/ Number of blades	f2.8-22 / 6
Min. focus distance	0.25 m / 9.84"
Length / Weight	113-132 mm/ 1.81 lb (821g)
Price	$2,950
Lab Test Results	
Center resolution [1] (max. aperture/ +2)	1662 / 1913
Edge resolution [1] (max. aperture/ +2)	1453 / 1465
Chrom. aberration [2] (max. aperture/ +2)	0.11 / 0.07
Distortion	-1 %
Vignetting [3] (max. aperture/ +2)	1.5 / 0.7
[1] in line pairs [2] in pixels [3] in f-stops	

Samyang 10mm f/2.8 NCS CS

The lens: This is the only lens we tested that can shoot ultra-wide-angle photos when used with an APS-C camera. Like its 15mm full-frame sibling, it has an obviously convex front element, a metal barrel and a plastic lens hood that is permanently attached. The aperture ring has a firm, positive movement and the focus ring has unusually long travel. Although its build quality is obviously not up to that of the more expensive competition, the Samyang is solid and easy to use.

Test results: Like the 15mm Samyang, this lens too performs best in the center of the frame, recording 1612 line pairs of resolution compared with only 1257 line pairs in the corners. Stopping down produced a slight improvement that we were able to measure in the lab but which isn't really visible in our test images. Vignetting came in at a reasonable 0.9 stops at maximum aperture and 0.5 pixels of chromatic aberration are great for a lens in this price range. Only distortion of 1.7 per cent lets the Samyang down.

Image quality: Our real-world test shots mirror our lab test results, producing very good center performance twinned with obviously poor edge performance. Overall image quality is fine and produces good detail contrast in the center of the frame. Distortion is particularly obvious in our studio test scene.

10mm f/2.8 NCS CS	
Focal length	10 mm (15 mm equiv.)
Aperture range/ Number of blades	f2.8-22 / 6
Min. focus distance	0.24 m / 9.45"
Length / Weight	103-132 mm / 1.3 lb (580 g)
Price (Nikon / Canon)	$449 / $429
Lab Test Results	
Center resolution [1] (max. aperture/ +2)	1612 / 1698
Edge resolution [1] (max. aperture/+2)	1257 / 1339
Chrom. aberration [2] (max. aperture/+2)	0.48 / 0.44
Distortion	-1.7 %
Vignetting [3] (max. aperture/ +2)	0.9 / 0.3
[1] in line pairs [2] in pixels [3] in f-stops	

The 15mm Zeiss is extremely well corrected and produces great detail rendition right up to the edges of the frame

Nikon D600 | 15mm Zeiss f/2.8 | ISO 100 | f4.5 | 1/125 s

Canon EF 20mm f/2.8 USM

The lens: The 20mm Canon is ten years old, making it one of the older designs in this issue's test. It looks quite large compared to the 20mm Sony (see opposite) and, at 405 g, weighs quite a lot more too. The body of this lens is made mostly of plastic and build quality is generally not quite up to the standard of its 14mm sibling. However, it does have a built-in auto/manual focus switch.

Test results: Our results were on a par with those of the Sony competition, measuring 1600 line pairs of center resolution and a less impressive value of 1114 line pairs at the edges of the frame when shooting wide open. At f5.6, center resolution increases to 1665 line pairs, while the edges of the frame measured 1350 line pairs between f5.6 and f11. At maximum aperture, 2.4 stops of vignetting are one of the least satisfactory results in this test, but this is balanced out to some degree by a moderate chromatic aberration reading of just 0.49 pixels. Stopping down to f5.6 reduces vignetting to just above one stop but chromatic aberration doesn't change much at all, regardless of the aperture setting. Overall distortion came in at just below one per cent.

Image quality: At maximum aperture, our outdoor test shots turned out with really dark corners, which could be used as a compositional element if only it weren't for the general lack of edge detail and contrast. Details in the center of the frame are much cleaner and are actually better than those reproduced by the 20mm Sony. Center performance is better stopped down but here too, edge definition is imprecise and is not up to the standard of the Nikon competition (see below).

EF 20mm f/2.8 USM	
Focal length	20 mm
Aperture range/ Number of blades	f2.8-22 / 6
Min. focus distance	0.25 m / 9.84"
Length / Weight	71 mm /14.29 oz (405 g)
Price	$489
Lab Test Results	
Center resolution [1] (max. aperture/ +2)	1601 / 1665
Edge resolution [1] (max. aperture/ +2)	1114 / 1319
Chrom. aberration [2] (max. aperture/ +2)	0.49 / 0.52
Distortion	-0.9 %
Vignetting [3] (max. aperture/ +2)	2.4 / 1.1
[1] in line pairs [2] in pixels [3] in f-stops	

AF-S NIKKOR 20mm f/1.8G ED

The lens: The NIKKOR has a mid-range price and its 20mm focal length means it cannnot be classed as an ultra-wide-angle lens. The barrel and focus ring are made of high-quality plastic and the lens is obviously aimed at autofocus users, who are sure to appreciate its fast, quiet AF motor. Its maximum aperture of f1.8 makes it the fastest lens in our test and enables you to use background blur in your compositions in spite of the short focal length. The front element is relatively small for this class of lens, making it possible to use conventional 77mm filters.

Test results: Even wide open, the NIKKOR produced very good center resolution of 1660 line pairs and improves to an excellent 1870 line pairs at f5.6. Edge performance remains at around 1480 line pairs throughout the aperture range. The lens is very well corrected, with virtually no visible chromatic aberration and a low distortion value of 0.8 per cent. The large maximum aperture produces a little more than one full stop of vignetting, but this value drops to a highly acceptable 0.4 at f5.6.

Image quality: The far corners of the frame were the only areas where sharpness is obviously inferior to that in the center, leading to a lack of contrast and weak textures. The NIKKOR produced better results under controlled conditions in the lab, producing good microcontrast right up to the edges of the frame. Textures such as the woodgrain in the artist's palette and the circuits in the circuit board are nicely defined (all test shots are included with this issue's free online content).

AF-S NIKKOR 20mm f/1.8G ED	
Focal length	20 mm
Aperture range/ Number of blades	f1.8-16 / 7
Min. focus distance	0.2 m / 7.9"
Length / Weight	83 mm / 12.6 oz (355 g)
Price	$800
Lab Test Results	
Center resolution [1] (max. aperture/ +2)	1660 / 1870
Edge resolution [1] (max. aperture/+2)	1485 / 1422
Chrom. aberration [2] (max. aperture/+2)	0.13 / 0.07
Distortion	-0.8 %
Vignetting [3] (max. aperture/ +2)	1.1 / 0.4
[1] in line pairs [2] in pixels [3] in f-stops	

HD Pentax DA 15mm f/4 ED AL Limited

The lens: With its equivalent focal length of 23mm, the Pentax is the 'longest' lens in our test and is also the smallest. Like all of the lenses in the Pentax 'Limited' range, build quality is excellent. The lens barrel and the cap are made of metal and the extendable lens hood is lined with black velvet. The manual focus movement is firm, but the shaft-driven autofocus mechanism is very loud compared with lenses that have built-in motors.

Test results: Our lab test results were disappointing. We can live with center resolution figures of 1584 and 1726 line pairs wide open and stopped down, but edge performance of 920 line pairs at f4 (maximum aperture for this lens) is very poor indeed. Even the bargain competition from Samyang performs better. Pentax has obviously paid more attention to error correction than overall image quality. Chromatic aberration is visible but is relatively easy to correct at the post-processing stage. Distortion of 0.5 per cent has no significant effect on perceived image quality. Vignetting, too, was not too troublesome, measuring 0.2 stops at f5.6 and 0.7 stops wide open.

Image quality: The center of the frame shows good contrast and detail rendition for our studio test scene, but overall quality diminishes toward the edges of the frame, with obvious reddish fringing at high-contrast edges. Our outdoor test shots mirrored these results, showing poor edge detail and additional green fringing too.

HD DA 15mm f/4 ED AL Limited	
Focal length	15 mm (23 mm equiv.)
Aperture range/ Number of blades	f4-22 / 7
Min. focus distance	0.18 m / 7.1"
Length / Weight	63 mm / 6.7 oz (189 g)
Price	$420
Lab Test Results	
Center resolution [1] (max. aperture/ +2)	1584 / 1726
Edge resolution [1] (max. aperture/ +2)	920 / 967
Chrom. aberration [2] (max. aperture/ +2)	0.67 / 0.64
Distortion	- 0.5 %
Vignetting [3] (max. aperture/ +2)	0.7 / 0.2
[1] in line pairs [2] in pixels [3] in f-stops	

Sony A-mount 20mm f/2.8

The lens: The Sony is one of the smallest lenses in this test, and is actually heavier than it looks. Overall build quality is good, although the very narrow focus ring has only a short travel, making precise focusing quite difficult. The focus ring in our test lens was quite loose too. Focusing is much more fun using the zoom function in the SLT a99's electronic viewfinder, especially if you are using the short minimum focus distance of just 9.84" to shoot 'fake miniatures'. Unlike the 20mm Canon, this lens has no built-in auto/manual focus switch.

Test results: Our lab tests produced mixed results. Used on the a99 at maximum aperture, center resolution came in at 1509 line pairs, with edge resolution of 1130, which is pretty weak. We also noticed very obvious vignetting of 2.2 stops. At f5.6, edge resolution increased to 1426 line pairs and the degree of vignetting fell back to just over one stop. Stopping down to f11 further improves both metrics, producing balanced results throughout the frame, but performance drops off again at f16 and beyond. Chromatic aberration is well corrected, measuring just 0.9 pixels wide open. The Sony's 0.9 per cent distortion is average for our test field and stopping down didn't really help matters. Used with an APS-C camera (in our case, an a77II), the lens has an equivalent focal length of 30 mm – a model that Sony doesn't offer in the APS-C A-mount configuration. Our comparison test produced results that, apart from slightly less obvious image artifacts, were no better than those we recorded using the full-frame camera.

Image quality: The most obvious feature of our maximum-aperture outdoor test shots was the vignetting effect, which produced a tunnel-like look that immediately guides the viewer's eye to the center of the frame. This effect definitely distracted us from the poor edge performance, which takes the form of clearly visible distortion, fringing and soft detail in our architectural shots. Things are much better in the center of the frame, although here too, the lens lacks that little extra detail contrast that would make the images look really lifelike. The Canon equivalent lens is better in most respects, and you have to stop down to at least f8 to get decent results from the Sony .

A-mount 20mm f/2.8	
Focal length	20 mm
Aperture range/ Number of blades	f2.8-22 / 7
Min. focus distance	0.25 m / 9.84"
Length / Weight	54 mm / 10.05 oz (285 g)
Price	$750
Lab Test Results	
Center resolution [1] (max. aperture/ +2)	1509 / 1493
Edge resolution [1] (max. aperture/+2)	1130 / 1426
Chrom. aberration [2] (max. aperture/+2)	0.99 / 0.62
Distortion	-0.9 %
Vignetting [3] (max. aperture/ +2)	2.2 / 1
[1] in line pairs [2] in pixels [3] in f-stops	

Zeiss Distagon T* 21mm f/2.8 ZE

The lens: This is one of the high-end lenses in our test field, and its Distagon geometry is one of the most important in the Zeiss lineup. The retrofocus design makes it possible to construct lenses with a wide angle of view and bright maximum apertures. Its 16 elements in 13 groups make this a large, heavy lens that weighs only about 100 g less than our EOS 6D test camera body. The finely machined focus ring is nicely grippy and its long travel makes precise focusing a sure-fire thing.

Test results: Wide open, the Zeiss recorded 1582 line pairs of center resolution and an acceptable reading of 1308 at the edges of the frame. Chromatic aberration is extremely well corrected, and measured just 0.27 pixels. Two stops of vignetting and one per cent distortion are not really good enough for this class of lens, but overall performance improves massively stopped down. At f5.6, chromatic aberration disappears almost completely and vignetting is reduced to 0.7 stops. At this aperture, we measured 1600 line pairs of center resolution and 1492 line pairs at the edges. This is one of the few lenses we tested that produced comparable performance when used with an APS-C camera with higher pixel density than the full-frame competition. In this case, we compared the results produced using an EOS 6D and an EOS 7D Mark II.

Image quality: Overall, the lens produces very clean images with a high degree of detail contrast. There is no visible fringing at maximum aperture, while vignetting and distortion are less obvious than in the Sony lens (see page 25).

Distagon T* 21mm f/2.8 ZE	
Focal length	21 mm
Aperture range/ Number of blades	f/2.8 - f/22 / 9
Min. focus distance	0.22 m / 8.66"
Length / Weight	109 mm / 1.32 lb (600 g)
Price	$1,850
Lab Test Results	
Center resolution [1] (max. aperture/ +2)	1582 / 1607
Edge resolution [1] (max. aperture/+2)	1308 / 1441
Chrom. aberration [2] (max. aperture/+2)	0.27 / 0.22
Distortion	-1 %
Vignetting [3] (max. aperture/ +2)	2 / 0.7
[1] in line pairs [2] in pixels [3] in f-stops	

The Mirrorless Competition – Fujifilm XF 14mm f/2.8 R

The lens: Camera manufacturer's own-brand ultra-wide-angle lenses for mirrorless system cameras are extremely rare, and third-party manufacturers such as Samyang have stepped in to fill this niche with bargain manual-focus offerings. Fujifilm is one of the very few manufacturers who offer a 21mm (equivalent) focal length lens for their high-end mirrorless cameras. This lens has excellent build quality but is still small and light compared with the full-frame competition. Pulling the focus ring toward the camera reveals a focus scale and switches the lens to manual mode. The focus ring on our test lens didn't rotate smoothly, probably due to poorly machined gearing. There is a separate ring for setting the aperture.

Test results: In the lab, the Fujifilm produced some of the best results in our test, recording100 per cent center resolution of 1632 line pairs wide open. Edge performance of 1368 line pairs is fine too. Edge performance improved to 1488 line pairs at f8 and quality only began to drop off again at f16. The 14mm was virtually distortion-free and 0.1 pixels of chromatic aberration are negligible. Vignetting, too, came in at a very good 0.6 stops wide open and 0.5 stopped down.

Image quality: Our real-world test shots reflected our lab test results very nicely. The images are clear and sharp at maximum aperture, with very good detail rendition in our architectural shots, although the edges are still softer than the center of the frame. Detail contrast is excellent throughout the aperture range, and we noticed no obvious fringing or other artifacts.

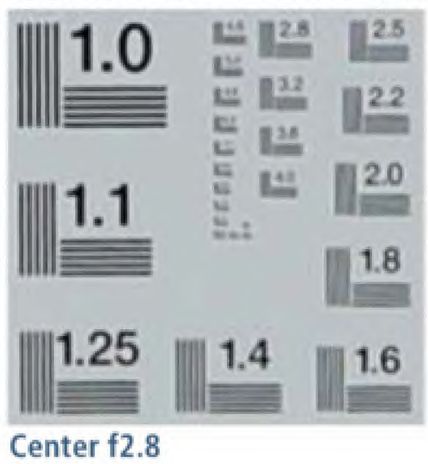
XF 14mm f/2.8 R	
Focal length	14 mm (21 mm equiv.)
Aperture range/ Number of blades	f2.8-22 / 7
Min. focus distance	0.18 m / 7.09"
Length / Weight	58 mm / 8.29 oz (235 g)
Price	$899
Lab Test Results	
Center resolution [1] (max. aperture/ +2)	1632 / 1632
Edge resolution [1] (max. aperture/+2)	1368 / 1463
Chrom. aberration [2] (max. aperture/+2)	0.1 / 0.09
Distortion	-0.1 %
Vignetting [3] (max. aperture/ +2)	0.6 / 0.5
[1] in line pairs [2] in pixels [3] in f-stops	

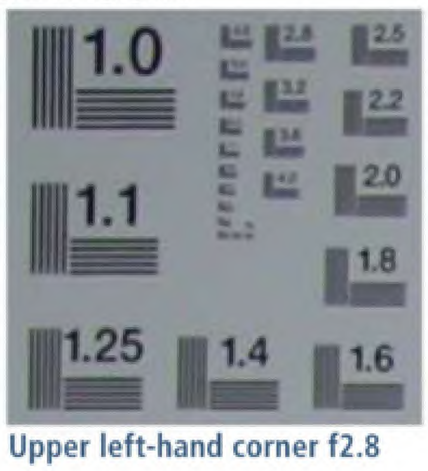
The wide-angle effect increases the drama in this shot of a corkscrew hazelnut tree and makes its branches look like strange writhing tentacles

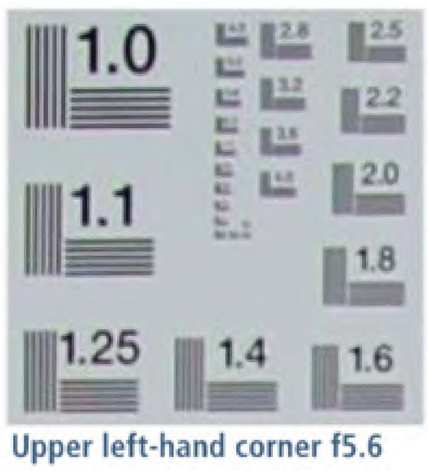
Canon EOS 6D with the Zeiss 21mm | ISO 100 | f16 | 0.8 s

Resolution and Image Artifacts

Canon EF 14mm f/2.8L II USM


Center f2.8


Upper left-hand corner f2.8

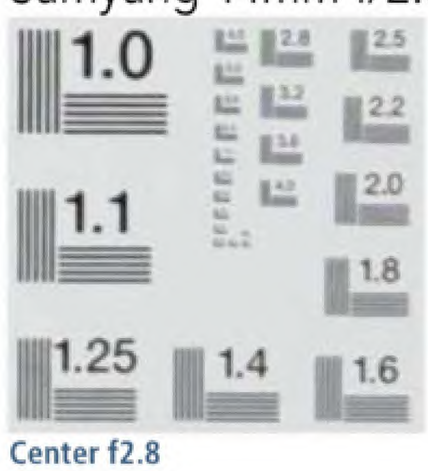

Upper left-hand corner f5.6

c't **studio test scene and outdoor test shot at ISO 100**

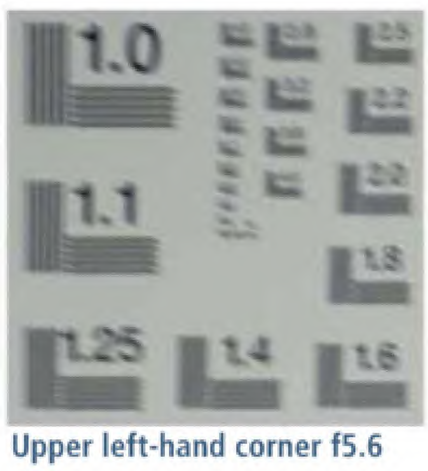

Upper left-hand corner f2.8


Upper left-hand corner f5.6

Samyang 14mm f/2.8 IF ED MC Aspherical


Center f2.8


Upper left-hand corner f2.8

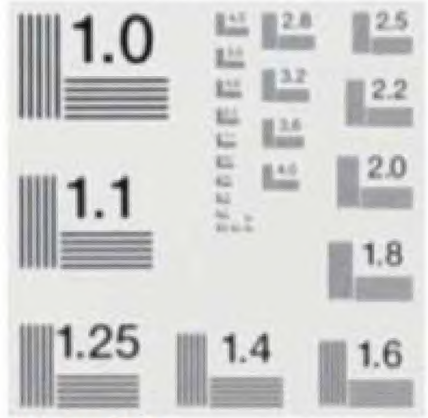

Upper left-hand corner f5.6

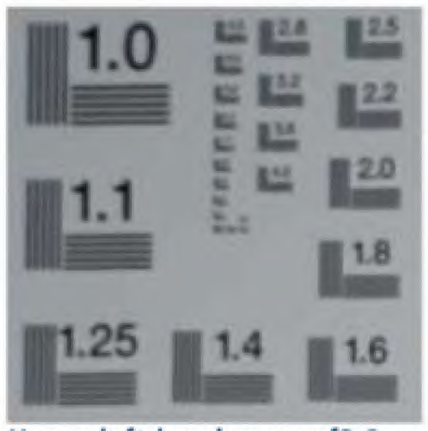
c't **studio test scene and outdoor test shot at ISO 100**

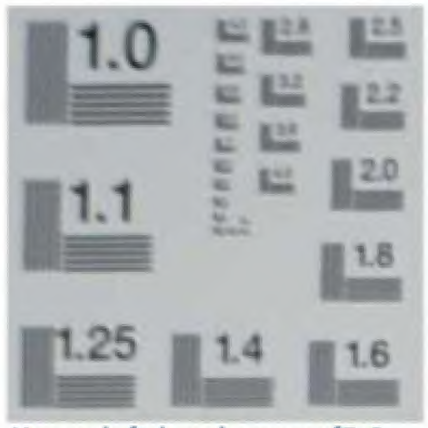

Upper left-hand corner f2.8


Upper left-hand corner f5.6

Zeiss ZF.2 15mm f/2.8


Center f2.8


Upper left-hand corner f2.8


Upper left-hand corner f5.6

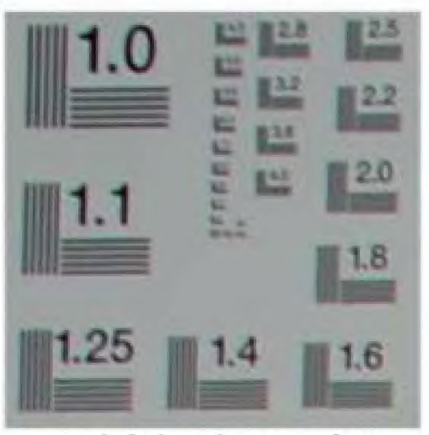
c't **studio test scene and outdoor test shot at ISO 100**

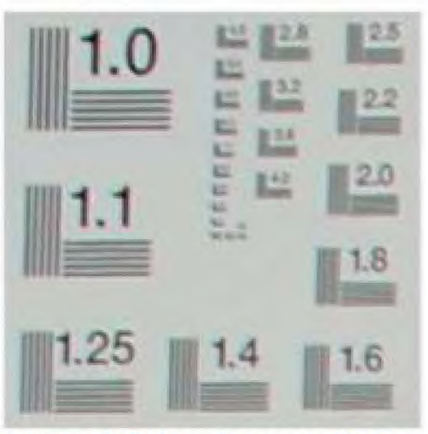

Upper left-hand corner f2.8


Upper left-hand corner f5.6

Samyang 10mm f/2.8


Center f2.8


Upper left-hand corner f2.8

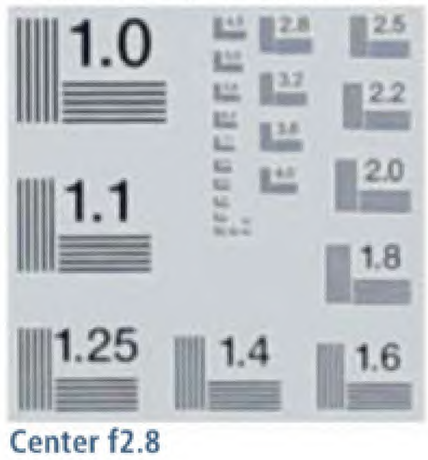

Upper left-hand corner f5.6

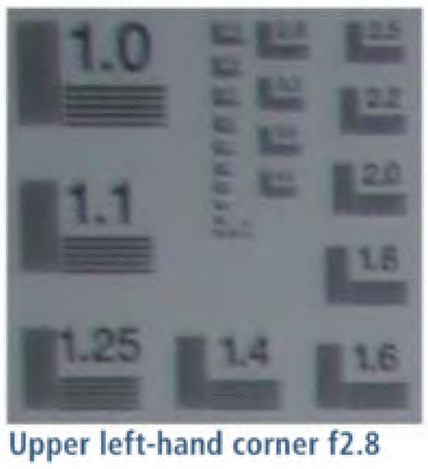
c't **studio test scene and outdoor test shot at ISO 100**

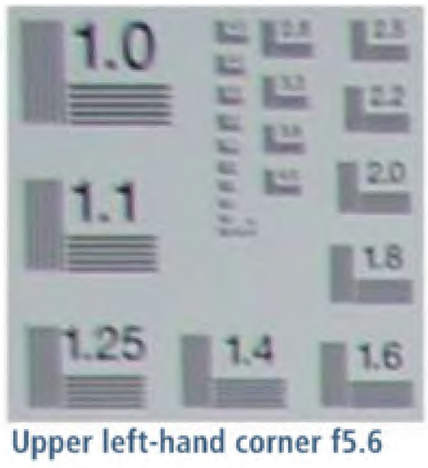

Upper left-hand corner f2.8


Upper left-hand corner f5.6

Canon EF 20mm f/2.8 USM


Center f2.8


Upper left-hand corner f2.8

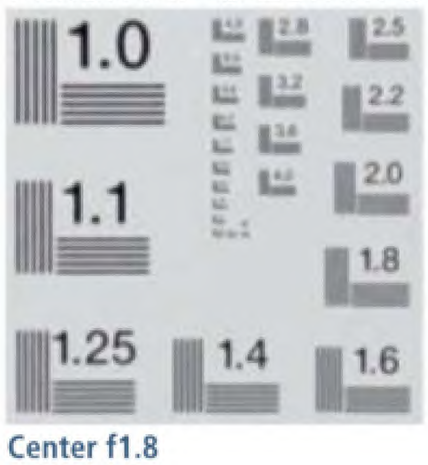

Upper left-hand corner f5.6

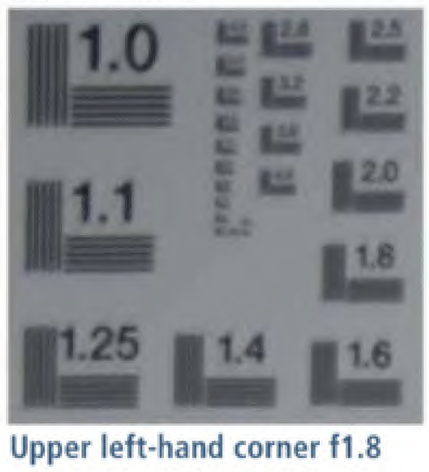
c't **studio test scene and outdoor test shot at ISO 100**

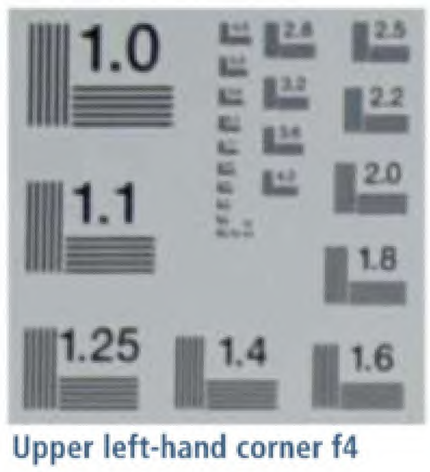

Upper left-hand corner f2.8


Upper left-hand corner f5.6

Nikon AF-S 20mm f/1.8G ED


Center f1.8


Upper left-hand corner f1.8

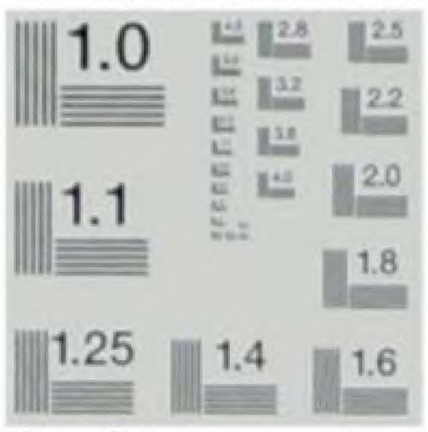

Upper left-hand corner f4

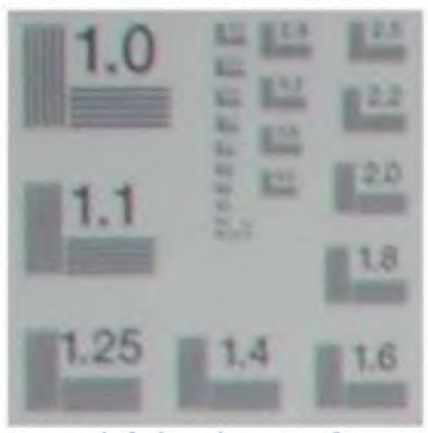
c't **studio test scene and outdoor test shot at ISO 100**

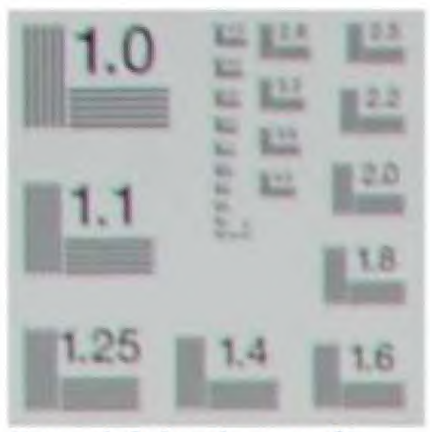

Upper left-hand corner f1.8


Upper left-hand corner f4

HD Pentax DA 15mm f/4 ED AL Limited


Center f4


Upper left-hand corner f4

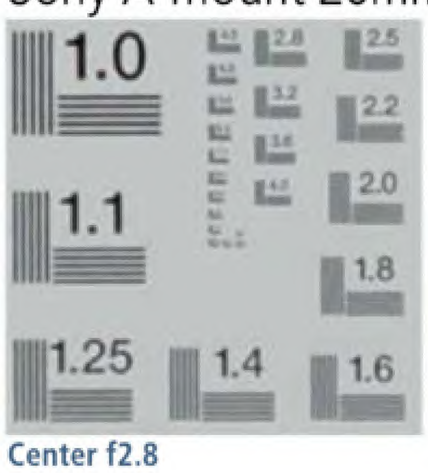

Upper left-hand corner f8

c't **studio test scene and outdoor test shot at ISO 100**

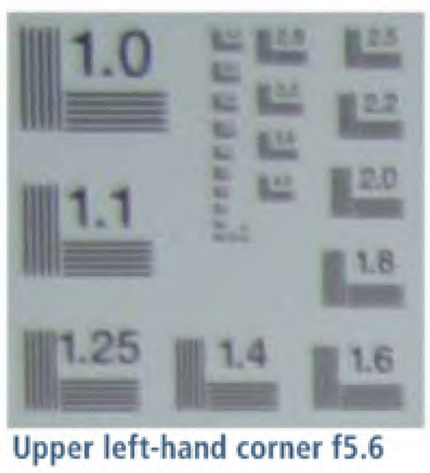

Upper left-hand corner f4


Upper left-hand corner f8

Sony A-mount 20mm f/2.8


Center f2.8


Upper left-hand corner f2.8

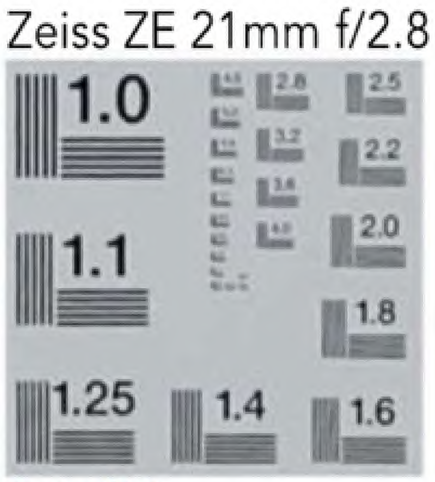

Upper left-hand corner f5.6

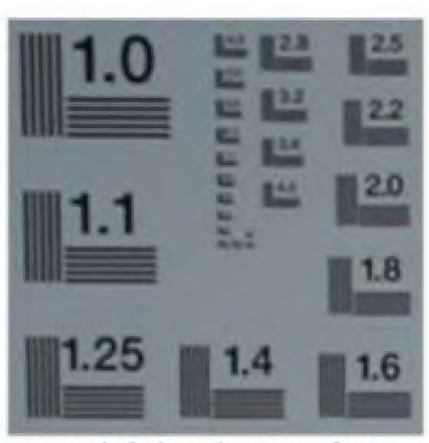
c't **studio test scene and outdoor test shot at ISO 100**

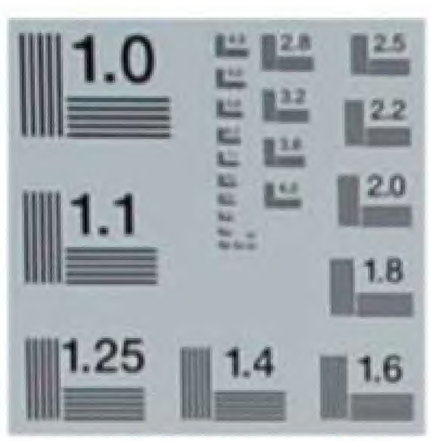

Upper left-hand corner f2.8


Upper left-hand corner f5.6

Zeiss ZE 21mm f/2.8


Center f2.8


Upper left-hand corner f2.8

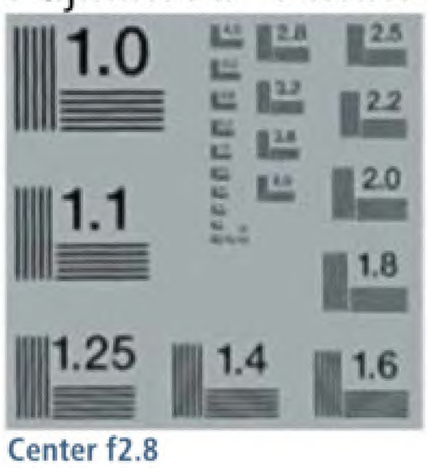

Upper left-hand corner f5.6

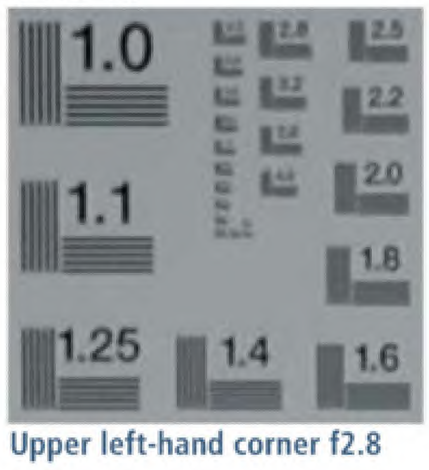
c't **studio test scene and outdoor test shot at ISO 100**

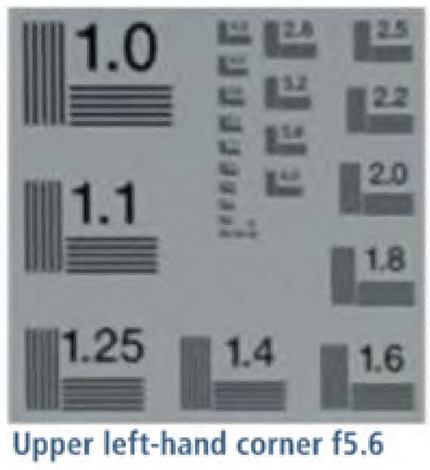

Upper left-hand corner f2.8


Upper left-hand corner f5.6

Fujifilm XF 14mm f/2.8 R


Center f2.8


Upper left-hand corner f2.8


Upper left-hand corner f5.6

c't **studio test scene and outdoor test shot at ISO 100**


Upper left-hand corner f2.8


Upper left-hand corner f5.6

Conclusions

Ultra-wide-angle lenses have angles of view of more than 80 degrees, making them a great choice for most landscape photographers. The unusual perspectives they offer enable you to include much more of a scene within the frame and emphasize individual details more effectively than you can using a standard lens. However, you have to compose carefully when using a lens like this – if you don't capture enough detail to really fill the frame, your images are sure to end up looking dull and uninteresting. These lenses force you to rethink your approach to photography.

All of the lenses tested here are worth looking at, and not one of them failed to impress in its own way. Having said that, they really do represent an extraordinary range of technical and practical considerations, and the range of prices varies enormously too, from $369 for the 14mm Samyang to nearly $3,000 for the 15mm Zeiss.

The cheaper a wide-angle lens is the smaller it seems to be. The Zeiss Distagon 15mm f/2.8 (right) is the largest and most expensive lens we tested. If required, Zeiss customer service will remove the built-in lens hood for a fee of around $300.

Cheaper = Less Performance

Quite simply, the higher the price, the better the quality, both build-wise and optically, although the cheaper lenses are all much more compact than their high-end counterparts.

Uncorrected lens errors are more of an issue in the cheaper lenses we tested, and edge performance was obviously weaker than that of the more expensive competition. Fringing, vignetting and some quite serious loss of contrast are the results. The 20mm Canon, for example, recorded 2.4 stops of vignetting at maximum aperture. This equates to an 81 per cent loss of brightness from the center to the edge of the frame and is very obvious in our test images. Among the cheaper lenses, stopping down doesn't always improve image quality.

While a vignette can still be considered a creative tool under some circumstances, it is more difficult to see the positive side of a lack of resolution. This was particularly obvious in the APS-C Pentax lens, which produced less than 50 per cent of its theoretical maximum resolution at f8 and is the only lens we tested that failed to make the critical mark of 1000 line pairs.

From Expensive High-end to Cheap and Useful

The higher-quality lenses we tested tend to show any weakness at the wide end of the aperture scale and generally deliver much more consistent, better balanced results. The Canon EF 14mm f/2.8L II USM performed particularly well and produced Zeiss-grade results stopped down.

Once again, Zeiss takes the prize for overall image quality, error correction and build quality. However, these lenses are only available in manual focus versions whose only nod to contemporary electronics is the transmission of aperture and focal length data to the camera.

The third-party lenses from Samyang are very well built for the price and offer performance that often matches – and sometimes even exceeds – that of camera manufacturers' own-brand glass. They produce good overall image quality, even if they do tend to produce slightly more distortion than the competition. They keep pace with their more expensive rivals in the resolution stakes, while other errors, such as chromatic aberration and vignetting, remain at acceptable levels. (tho)

Uncorrected errors can be used deliberately as a stylistic device. A vignette emphasizes the details in the center of the frame, while the wide angle of view produces a highly spatial effect with interesting background transitions and textures. c't

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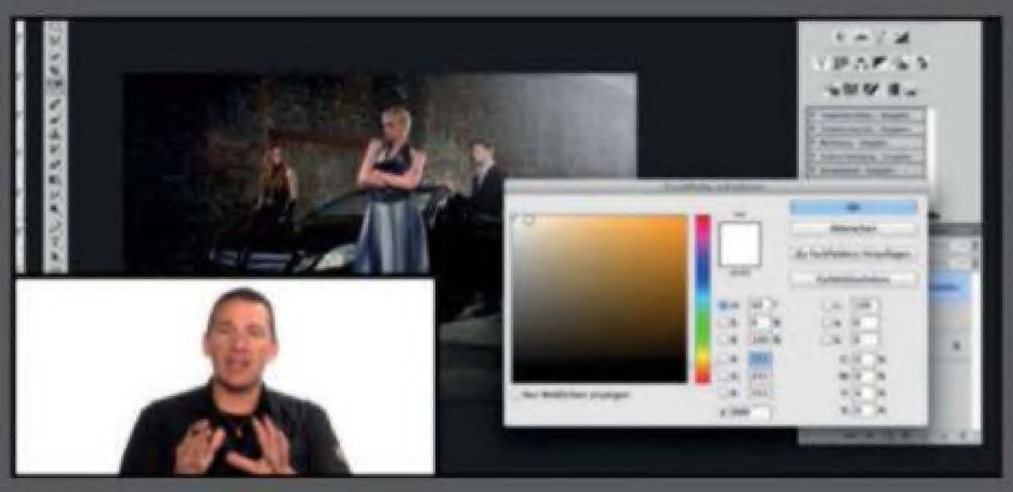

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Pavel Kaplun

Composing with Color

Do you set out to make the most of color as a design element, both when you are shooting and during post-processing? This workshop introduces the wonderful possibilities that color offers. Using images from his latest trip to India, Pavel Kaplun explains why they look the way they do and how using color at the post-processing stage changes the way they affect the viewer.

In January of this year, I found myself in India, a country that seems to polarize opinion whenever it is discussed. I had only two set destinations, Jaipur and Goa. Everything else in the way of locations and subjects would come clear as we travelled. But all our planning and thinking went out the window – in a positive sense – once we experienced the fascination and otherness of this amazing country. It was all so intense: the food, the smells, our impressions of people's lives

This intensity, which I could feel everywhere, morphed into the main theme of my work, which I called 'Composing with Color'. As a child I used to peer intently into kaleidoscopes, fascinated by all the colors and the way they constantly rearranged themselves. India had a very similar effect on me. Using color as a design element means both being playful with the colors that the subject itself provides and adding color, rather like 'painting by numbers', except that in this case, I choose the numbers myself and add them later, during post-processing, for maximum artistic effect.

Choosing the Subject: Images with Color Potential

The images discussed in this workshop represent the entire spectrum of ways in which color can be used as a design element. I hope they spur you on to experiment and have fun in your own work. Libraries are full of books on the theory of color, but I want to concentrate here on practical matters. Color as a highlight, a midtone or a shadow can:

– make an image livelier
– bring the main subject(s) to the fore
– emphasize proportions
– make unimportant things fade into the background
– add interest and depth to an image
– set the basic 'feel' of an image

That may sound like overpromising, but it is amazing what color can do. Using color to change the effect of an image is a lot of fun. There is no need to alter a photo's compostion in order to achieve great results. Rather, pushing the limits of the color potential inherent in an image using relatively simple means and methods is quite sufficient, as the following examples show. You'll need a basic knowledge of post-processing principles and we'll show you the effects you can achieve, even if we don't list exactly which sliders to set and menus to use. The steps I used to process the Water Palace image on page 66 are explained in detail in the workshop on page 76.

Pavel Kaplun

Pavel Kaplun – photographer, photographic artist, graphic artist and trainer – is one of Germany's movers and shakers in the field of image processing. Collages that tell stories and blend the look of an Old Master oil painting with the power of photography are his trademark.

Kaplun owns and operates a creative studio in Hannover, contracts to numerous companies as a post-producer and runs events and seminars. In 2014, he began offering international photographic tours.

For more on his work, visit
www.kaplun.de

Travel Photography: Keep it Simple

To get the results you want in travel photography, you have to do a lot of planning. But no matter how well you plan, it is impossible to anticipate everything. Expect the unexpected in a foreign country! And don't let your preparations fill your mind with so many expectations and ideas before you go that there is no room left to fully experience being there, using all your senses to take it in. You have to be open-minded and flexible, and adapt to fit in with the local way of doing things. A truly local flavor is often what clarifies the true purpose of a photo, giving you direction both while you are shooting and when you are processing at home..

When I'm travelling and passing my impressions on to others through my photos, I concentrate on things that other people could also do or achieve. I don't spend the night in a tent at 7,000 meters or attempt week-long commando-style marches through the jungle. Such methods may produce awesome photos, but are impossible for most people to achieve. So I go where most of us can go using everyday modes of transport. I shoot with an artist's eye and arrange things so that the image looks individual and unique and people feel they can learn to do the same.

The Sacred Cow

The streets of India – trash included – are ultra colorful. If you only look at the dirt, you miss what the street really has to offer. As always, photography is not just about capturing what may be a special moment, but also about recognizing and using the potential in a subject. This photo of a cow, considered a sacred animal in India, was taken during an evening stroll in Jaipur.

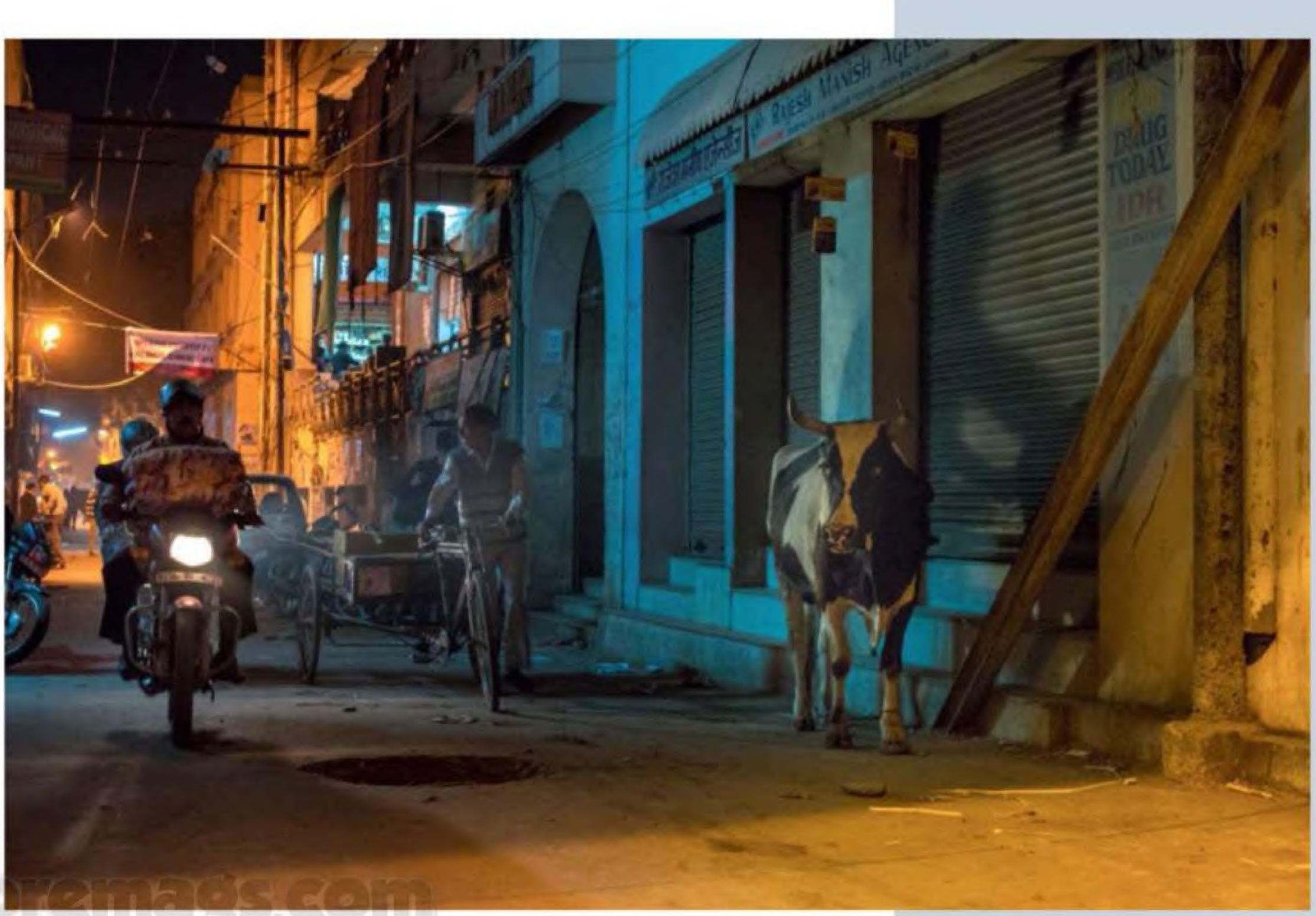
What seems chaotic to us is the fabric of daily life for locals. The streets are abuzz with vehicles of all shapes and sizes, cows, stray dogs, passers-by, an unimaginable variety of shops and stalls… and all lit so fantastically that you cannot help but explore new ways of using color.

To our eyes, the street scene is strikingly different. But what else makes this a good image? The composition of the original is very good: the cow as an eye-catcher, nicely framed by the balconies and the shadows on the right and left, and the retreating street that adds depth.

But it is color that lends this image an extra 'kick', particularly the two complementary colors, which were intensified slightly during post-processing. I added extra pale orange light to the cow and the motorcyclist to create further color contrast, and the image came to life. Color contrasts do something else, too: ramshackle buildings get an instant makevoer, dirt becomes invisible and the whole scene acquires additional elegance.

The original image

The complementary colors orange and blue are intensified and the sacred cow becomes brighter



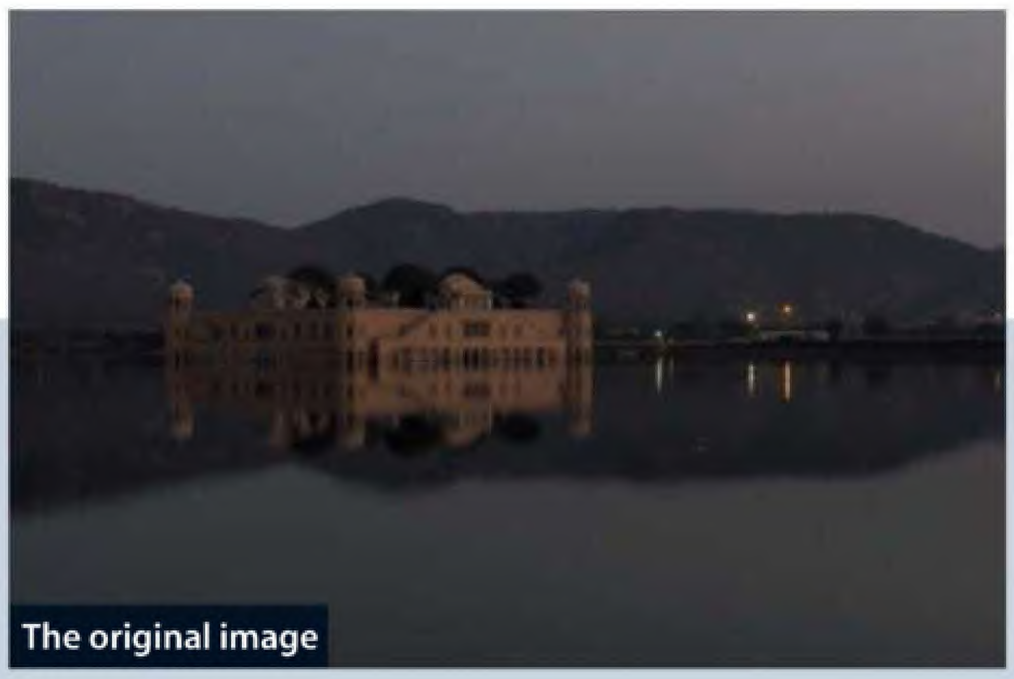
Water Palace (Jal Mahal)

Jal Mahal, which means 'Water Palace' (more or less), is one of the most imposing sights in Jaipur. Virtually every tourist takes a photo of it, not least because of the fabulous surroundings – in the middle of a lake, partly under the water's surface, and with breathtaking reflections. The only prerequisite is that the weather plays its part.

Because there are no tours of the palace, most tourists just stop on the side of the road to take a photo. Even if such photos are taken literally 'in passing', it doesn't make the Water Palace any less attractive.

Does a beautiful subject become any less beautiful just because it is on the tour group 'must see' list? Never! Post-processing is the key. A carefully targeted color shift toward blue, with a touch of green in the sky and on the water, a touch of color on the palace itself, and the color contrast and glowing effect give the setting a mystical feel and direct all our attention to the building itself.

No camera can produce an original image that truly conveys what it feels like to stand and gaze at this beautiful place. Color creates the intensity and excitement that one experiences at the site. Here, we can see how color makes things even more gorgeous. For more detail on how this image was processed, see the tutorial on page 76.



The original image

Careful color shifting in the sky and on the water, and the addition of a spot of color on the palace, make the subject even more gorgeous

Spontaneous Portraits

In Goa, you can tour a spice plantation on your way to the southern beaches. Even if you're not all that interested in botany, as a photographer you are sure to find the primeval feeling of the forest backdrop highly appealing. These two women had the job of placing flowers on the heads of the visitors.

A spontaneous portrait just 'happened'. I didn't give any instructions, there was no makeup artist on hand and no artificial lighting. Yet despite all the naturalness, the original image feels kind of flat and lackluster, and the background does not have the radiance I perceived when I made the shot.

Again, color processing is the cure. I intensified the green tones considerably and mixed in a little yellow to make the general tone warmer. Then I darkened some areas slightly, so that the light emphasizes the women. I made the light yellow to fit in with the rest of the image.

The women's clothing complements the surroundings perfectly. All I had to do was warm up the green tones a little and intensify the reds. The result is a balanced image in which the women are charmingly set apart from the background and take on a suitably dignified presence. Once again, color played a decisive role in creating the overall mood.

How color can change the underlying feel of an image. More intense green tones and a slight darkening came to the rescue of a somewhat lifeless original.

The original image

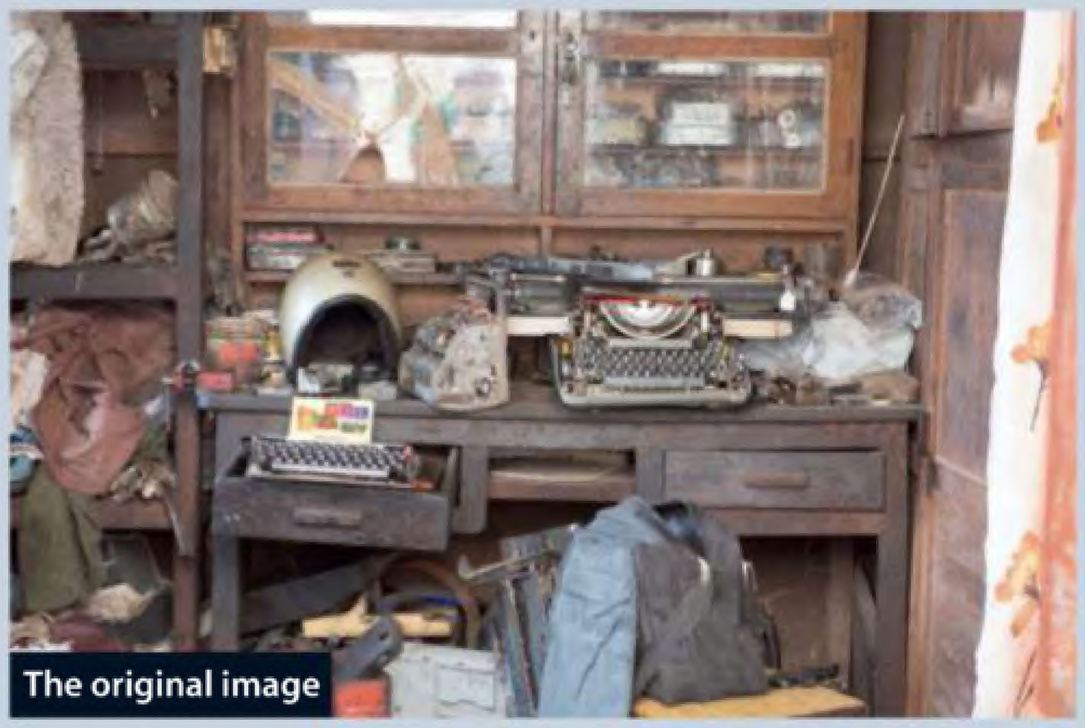
Deluxe Decay

India offers subjects ranging from sublime and grand to decayed and dilapidated, small and unspectacular to huge and opulent. The reasons for the decay and decline are complex and not to be unraveled in one short trip. But a photo serves as a kind of testimony of how things were at a particular moment in time.

This image, taken on a walk through Panjim in Goa, had me riveted at once. There is dirt, dust and chaos, but also huge design potential.

Color accents, combined with a little vignetting, can work wonders here. Additional orange light, which complements the timber, draws the viewer's eye into the the image and creates depth. The blue-green contrast in the jacket, the glass, the helmet and to the right of the image make it more dynamic, and connecting the corners of this area creates a triangle that discreetly makes the image more balanced.

To finish up, I intensified the colors in the flyer on the typewriter because the words on it make a wonderful title for the image and should leap out at the viewer. And there you have it: 'Deluxe Decay'. The 'deluxe' element comes from the careful use of color that renders dirt and decay timeless and artistic.



The original image

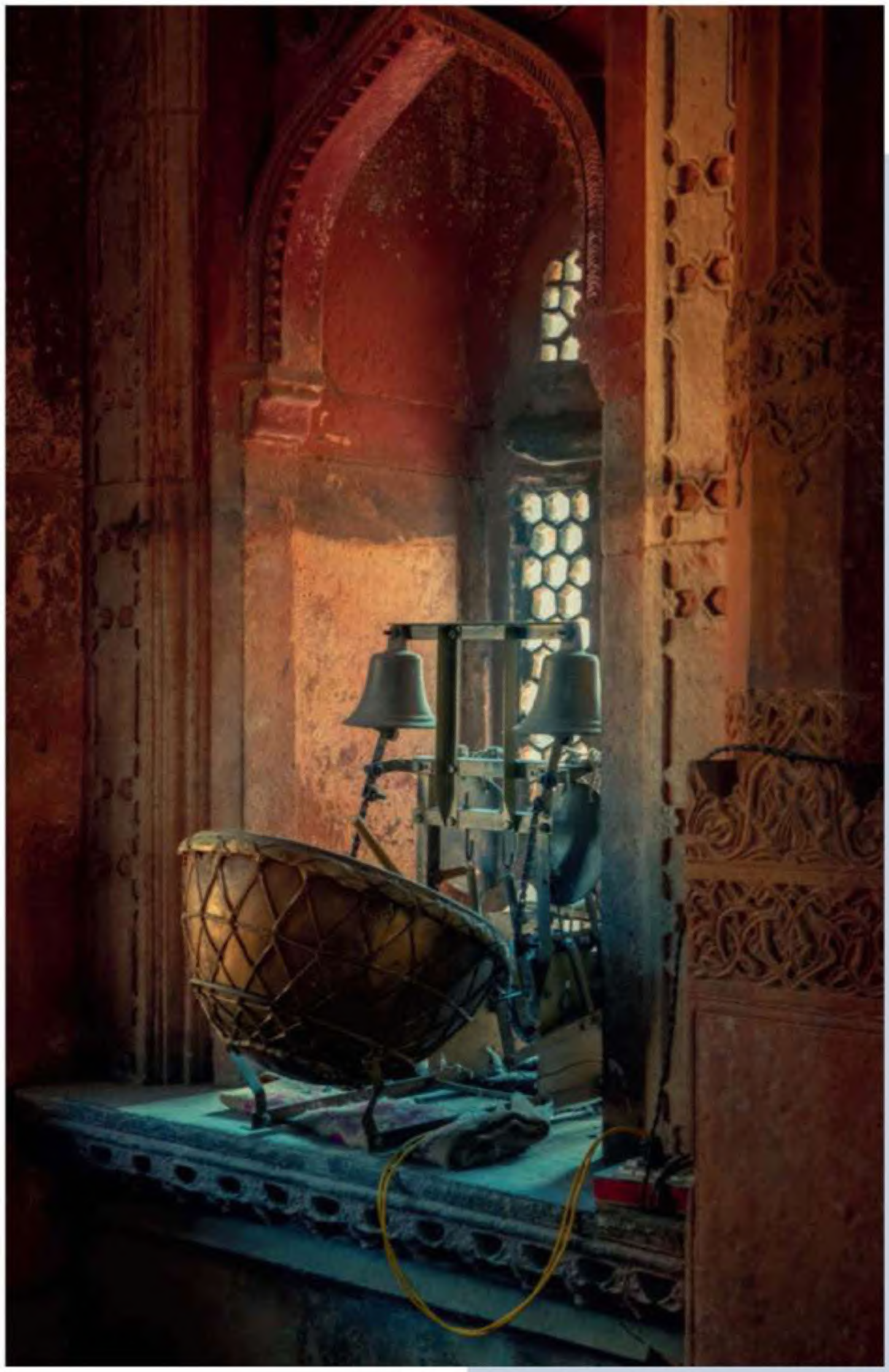
Skillful use of color makes dirt and decay look timeless and refined

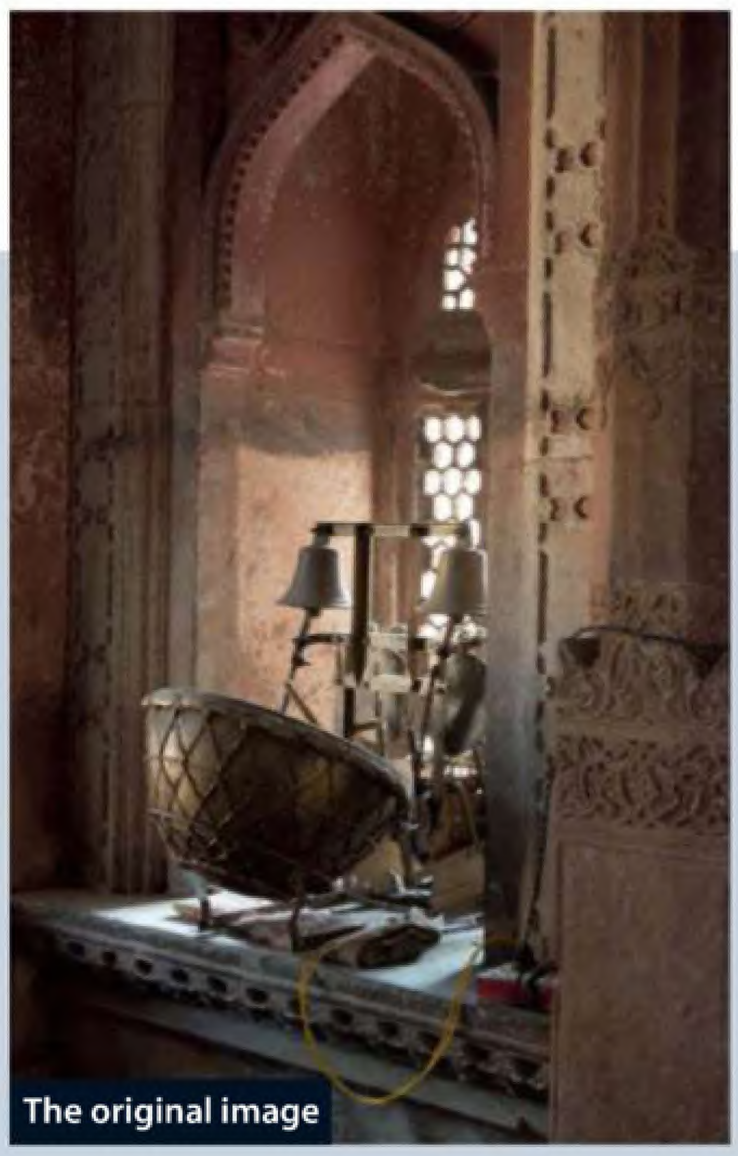
Temple Lights

This image, taken at Sri Jagat Stromaniji Temple, shows perhaps most clearly what color can do when used skillfully. This little jewel in the shadow of the Amber Fort is often unjustly overlooked. We were the only ones here, while thousands of people were strolling around only a few hundred meters away. The peace and solitude conveyed by so many tiny sources of light created an awe-inspiring atmosphere that is simply not reflected in the original image.

Heightened color contrasts take the atmosphere to a whole new level. Additional red underscores the basic color of the sandstone while keeping it natural-looking, and a little turquoise added where the light touches the windowsill and the metal adds contrast. To keep the image balanced, the drum also gets a bit of orange highlighting.

The color design in this image is not complicated, but the effect is eye-catching and authentic – it is almost like being there. Imagine hanging these two images on a wall at home. Which one would you keep there longer because you just can't get enough of it? My favorite is definitely the processed version. In this type of image, the trick is to strike a balance between intensity and naturalness. If you apply just enough color to keep the image authentic-looking, you will achieve the maximum effect. In this case, processing makes the temple really glow.





The original image

The art of using color effects skillfully lies in striking the right balance between intensity and naturalness

A Change of Perspective

For photographers, traveling always means getting a fresh perspective on life and the world, both literally and metaphorically. One of the visual highlights of my India trip was a ride in a hot-air balloon: absolute silence, an uninterrupted view of a spectacular landscape and the magic of the rising sun.

Sadly, the original image doesn't convey enough of that specialness. The human eye is superior to a camera in these things, but the detail captured with the image data makes it possible to add color and reproduce what I experienced high in the air.

I brightened the image, of course, but leaving it at that would leave the image just as flat and emotionless as when I started. Color is still missing; the land was bathed in golden light at sunrise, so I added plenty of that to the horizon and the valley floor. The image feels totally different already.

Having intervened in the lower half of the image, we have to tweak the upper half too, to keep it balanced. Darkening the upper edge and intensifying the blue of the sky draws the viewer's attention to the center of the frame. A pure blue would be too intense for this image and divert the eye from the balloon, so I gave the blue a slight green tint. Those who are familiar with my work know that I'm fond of dipping into that pot and that 'Kaplun blue' is part of my style.

At this stage, the balloon (which is the real subject) lacks verve compared with the rest of the image. To make it glow, I added orange spots to the flame and the upper third of the balloon. Now it looks three-dimensional and vivid and looks like it belongs to its surroundings. Here, I used color to change the perspective and alter the fundamental mood of the image to accentuate the main subject. The reproduction on the monitor now precisely mirrors how I felt when I experienced the original scene.

The original image

When tricky lighting conditions mean that an image does not convey the feelings evoked by the original scene, careful color processing can bring back what the photographer experienced

In the Street

India is a street photographer's paradise. There are shops lining the streets left and right, traffic like nowhere else on earth and animals that enliven the streetscape. Most of all, there is color everywhere in the hustle and bustle by day and by night.

This photo was taken on an evening walk through Jaipur, not because the goods on display in the shops looked so lovely, but because the shopkeeper had such a special aura about him. Even though the colors he is wearing attract our eye, he is drowned out by the many brilliantly colored elements in the foreground and background. We can correct that with color and use color contrast to direct all eyes to the real subject. Using a wide aperture helped to underscore this effect

We can use red-orange light to accentuate and brighten the man's red clothing, while balancing the color and brightness of the background and the goods in the foreground underscore the effect. A matt blue makes the background recede still farther and the various textures less obvious.

The contrast between blue and red and slight vignetting of the edges does the rest. Comparing the result to the original, it is now clear what the main subject of this image is. The right use of color clinches the deal here and enhances the artistic flair of the image.

The original image

Additional red-orange light accentuates the red clothing and, together with other lighting effects, makes the shopkeeper the main focus of attention

Color Rush

The original photo was taken on the beach in Goa in the early evening. A long exposure smoothed out the breakers, but we were limited in the length of the exposure we were able to use because huge waves came every seven seconds or so that would otherwise have swamped the camera.

Whatever the lighting, images and scenes like this are perfect for playing with color. Dusk, surreal surf, ocean spray and the craggy cliffs demand a mystical color scheme. The old adage 'All cats are gray in the dark' applies perfectly to this particular photo.

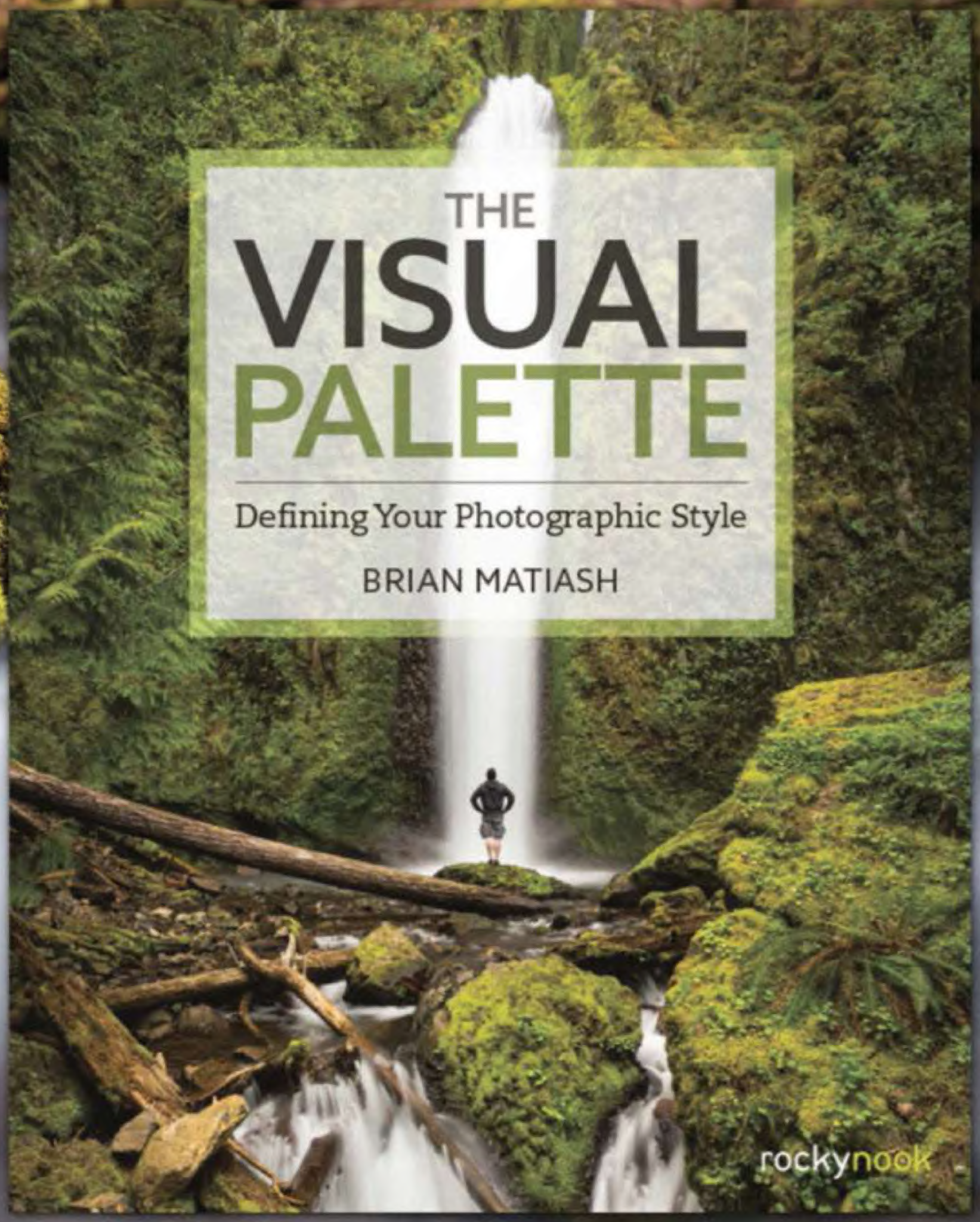
But color changes everything. The sun is setting behind the cliff on the right and additional orange light here and on the cliff on the left brings it back into play. As a total opposite, I colored the cliffs on the right cold blue, just like the cliff in the lower left-hand corner. To achieve a mystical effect, we need to apply color liberally to the sky and the surface of the water too.

In an image like this, it is too easy to fall prey to the temptation to use a conventional blue tone for the sky, so I used a tone with a strong magenta component instead and added it to the surface of the water too. I also added a few warm and cool color spots to the edge of the water to make the image more dynamic. The result is a dreamlike beach scene, thanks solely to color.

The original image

Using additional color gives this beach scene a surreal touch

DISCOVER YOUR STYLE



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Grandiose Monuments

One of the significant monuments in Jaipur is the Amber Fort, a vast former royal palace that has lost none of its splendor. The Fort is a worthy subject by night or by day, but shooting just before dusk is the best way to make color work for you and create images that stand out from the ubiquitous tourist snapshots.

Color enables you to create an image that has a daylight feel in parts but also glows in a way only seen in the evening. Extra blue at the upper edge produces a balanced daylight effect, while light on the fort itself highlights the color of the sandstone, which did not appear at its best in the twilight. But that's not all. Orange light spots on the arches make the Fort look as if it is floodlit.

These intense but realistic color contrasts breathe new life into the buildings, making them appear more three-dimensional and looking at the photo almost as good as being there.

Using blue in the sky, orange on the building and various targeted light spots makes this evening view of the Amber Fort in Jaipur look as if it is floodlit

The original image

The Upshot: Get Out of the Digital Mainstream

Tastes differ, for sure, but color as a design tool works every time and is applicable in all genres, not just travel photography.

If you're reasonably familiar with digital editing processes, you might think: "That's easy. You can do just about anything with Adobe Camera Raw or some similar tool." That's true, but we must never forget that we are photographers who design and create in a highly intentional way. That means more than just using yet another technique or tool.

The same goes for ready-made looks, presets and other things designed to make a photographer's life easier. Use these tools by all means, but don't throw the baby out with the bathwater and give up your creative freedom.

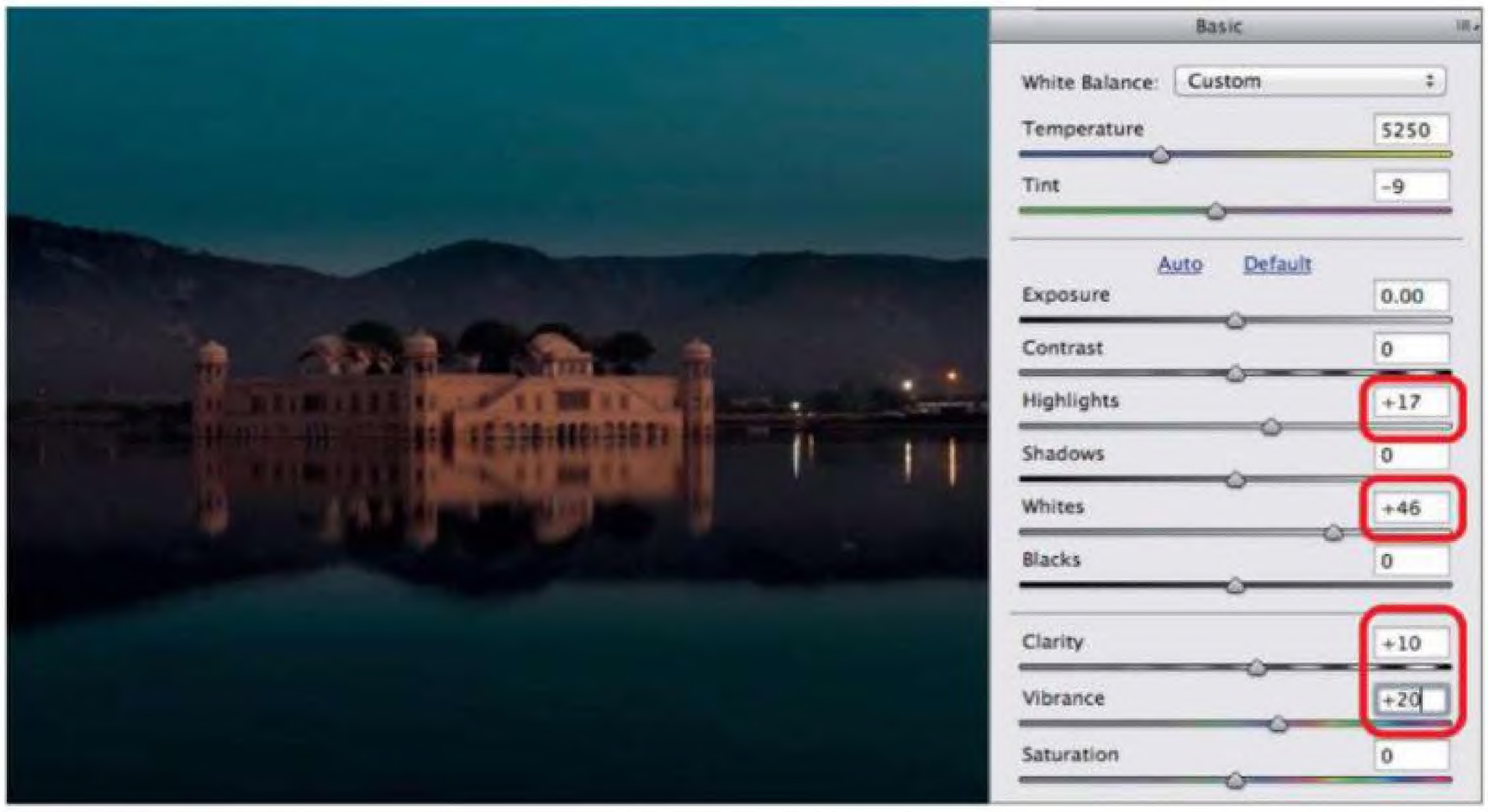
This is the time to make your mark. Otherwise your prints will turn out like a microwave dinner – all you have to do is press the button. The result may be tasty, but millions of other people are eating exactly the same meal.

Have the courage to express yourself in color, celebrate your artistic flair and individuality and, whatever you do, don't forget to have fun! (jr)

Composing with Color in Adobe Camera Raw

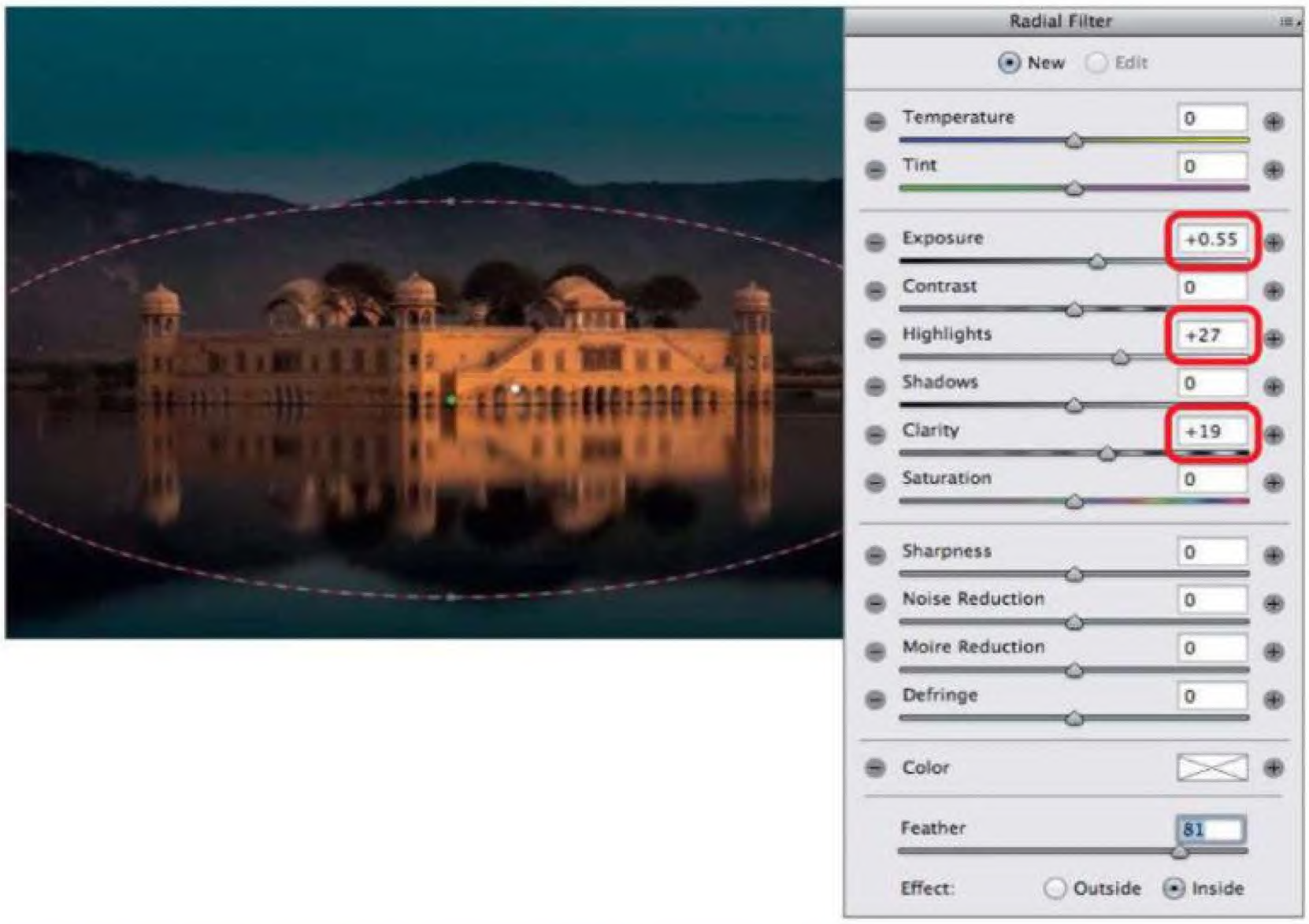
The following pages demonstrate the processing steps applied to the 'Water Palace' image shown on page 66.

1 These are the basic settings I made before adding radial filters to enhance the look of the fort between the water and the sky. I didn't brighten the entire image, as darkness plays a role in the overall composition. I only lightened the Whites (+46) and adjusted the Highlights (+17) to increase contrast and emphasize the building. I also adjusted Clarity to +10 and Vibrance to +20.



2 Following additional sharpening, I added a broad radial filter. I raised the Temperature value to +20 to get the 'glow' effect I was looking for and brightened the highlights slightly with a setting of +16.

3 This is the most important step. An elliptical radial filter with an Exposure setting of +0.55, a Highlights setting of +27 and a Clarity setting of +19 lights up the fort and separates it beautifully from the background.



4 I optimized the colors in the fort using the HSL/Grayscale tool. In the Hue tab, I added +13 to the Yellows and Oranges, and then adjusted Oranges to +10 in the Saturation tab to enhance the building's glow. Additionally, I increased the saturation in the Aquas and Blues to +20.

5 To finish up, I cropped the processed image and used the Split Toning tool to apply a slight color shift (Hue 56, Saturation 30).

Thomas Gade, Sascha Steinhoff

Telescope or Telephoto?

Chinese manufacturers now dominate the market for high-quality, low-budget telescopes that are great for capturing terrestrial images as well as star-gazing. For this article, we tested a range of popular models and checked out their potential as a real alternative to expensive telephoto lenses.

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Photographers who want to bring distant subjects closer usually use a telephoto lens, and there is a wide range of models available for most DSLR and mirrorless systems. Good-quality telephoto lenses produce good results because they are designed specifically for use with cameras, but looking at the current state of the market for lenses with focal lengths of 400 mm and more reveals a number of reasons to consider using a telescope instead of a telephoto lens.

Fixed Focal Length Refractive Lenses

At the cheap end of the scale, you can purchase refractive lenses with simple designs and focal lengths of 500 mm or more for less than $100. For example, the Bower/Neewer 500mm f/8 (see below), with its T2 thread and fixed aperture, can be adapted for use with most popular camera systems. This manual-focus lens was designed in the 1970s and produces images of a quality that match its specifications – in other words, good but not great. Its length of around 15 inches is anything but compact. What most users aren't aware of is that the lens has the same basic design as a refractive telescope with a built-in field flattener (more on this later).

If you want to make the most of your camera's automatic exposure and metering functionality while capturing high-quality images, you are usually better off using a dedicated telephoto lens with a large maximum aperture and a high-end price tag to match. Own-brand lenses of this type from Nikon and Canon are an essential part of any professional sports or wildlife photographer's kit, with focal lengths of up to 800 mm the order of the day. Fixed focal length telephotos have simpler designs than their zoom counterparts and are priced from $6,700 for a Sigma 800mm f/5.6 to $13,000 for the equivalent Canon EF 800mm F/5.6L IS USM. If you need even more range, ultra-long special-edition lenses such as Canon's legendary EF 1200m f/5.6L USM are the answer. Lenses like this can weigh as much as 35 lb, which makes them tricky to handle, especially if you are shooting alone. Back in the day, the 1200mm Canon cost $120,000; it is but is no longer in production, however, and the upper end of the range is now firmly pegged at the 800mm mark.

One way to increase the focal length of a long lens is to use a teleconverter. The downside of this approach is that it reduces the maximum available aperture and image quality, and often means that you have to shoot without autofocus. Teleconverters make sense in some situations if used with a high-end telephoto but are no good for extending the range of a zoom.

Fixed Focal Length Mirror Lenses

While there is a wide choice of refractive lenses in all price segments, the market for mirror telephotos is relatively small and consists largely of outdated designs that haven't been overhauled in years. Camera manufacturers such as Nikon and Sony/Minolta have stopped making mirror lenses, but fans of this type of lens don't seem to mind and are faithful to the tried-and-trusted, cheap-and-cheerful designs of yesteryear. For example, the Samyang 800mm f/8 mirror lens costs just $190. At only 5.6" long, it is tempting to use it handheld, but it is actually quite difficult to produce shake-free images without a tripod.

The Nikon TC-800 1.25× teleconverter supplied with the AF-S NIKKOR 800mm f/4E transforms the lens into a 1000mm monster with a maximum aperture of f7.1

Additionally, it is extremely difficult to focus precisely using a mirror telephoto, as even tiny movements of the focus ring produce significant changes in the distance setting. In contrast, telescopes with comparable focal lengths are usually equipped with a powerful eyepiece that makes focusing much easier and more precise. Mirror telephoto lenses also produce unique 'donut'-style bokeh and surreal-looking edge artifacts that only a tiny of minority of photographers consider aesthetically pleasing. Most are manual focus only, though there are exceptions, such as the 500mm f/8 Minolta, which is no longer in production. Although the term 'mirror telephoto' implies a lack of conventional lens elements, these lenses always incorporate glass elements too. Mirror telephotos usually have a fixed aperture. Zoom mirror lenses, such as the legacy 500-800mm f/8-12 Soligor, are extremely difficult to come by, even on the used market.

Our secret weapon! The Bower 500mm f/8 (also sold under the Neewer brand) is a real bargain at just $99. Designed in the 1970s, it can be used with most popular interchangeable-lens camera systems with the help of a T2 adapter.

The Sigma 150-500mm f/5-6.3 APO DG OS represents a good compromise between a useful zoom range and a reasonably large maximum aperture. Its $700 price tag is moderate, but so is its maximum aperture at the long end.

Refractive Zoom Lenses

Where there is a demand, someone will supply a product, according to the economists. This maxim certainly holds true in the rarified world of super-telephoto zoom lenses, where you can find really cheap models, such as the $240 Samyang 650-1300mm f/8-16, although even the 500mm Bower (see page 79) is an optical masterpiece in comparison. This type of lens is fun to play with but isn't really suited to the pursuit of serious photography. High-quality telephoto zooms are expensive and usually have a fairly limited zoom range. For example, the Tamron 150-600mm f/5-6.3 Di VC USD costs around $1,100 but, if you need more range, you will have to spend around $7,000 for the Sigma 300-800mm f/5.6 EX DG APO IF HSM. If you are prepared to compromise on range but not maximum aperture, the Sigma 200-500mm f/2.8 might just fit the bill, although its $26,000 price tag and 34.5 lb weight probably make it a pro-only option.

High-quality ultra-long zooms are usually equipped with autofocus and image stabilizers but are complicated to build, especially if they are to provide usable maximum apertures. They often show obvious image quality falloff at maximum aperture and the long end of the range where quality is of the essence. The market for this type of lens has long been dominated by third-party manufacturers Tamron and Sigma, although Nikon announced a 200-500mm f/5.6 lens for around $2,400 shortly before we went to press.

Ultra-long Alternatives

Although there are many ultra-long lenses available, models that produce high-quality images for a reasonable price are few and far between. For photographers who are happy to experiment, telescopes are the obvious alternative. Their focal lengths start where those of conventional camera lenses peter out and are often quoted in meters rather than millimeters. With Chinese manufacturers now dominating the market, you can find high-quality optics at user-friendly prices.

Of course, using a telescope to take photos is more complicated than using a purpose-built camera lens. The following pages explain how to make the leap and what to look for when purchasing a camera-compatible telescope. To round things out, we also tested and compared telephoto lenses and telescopes in a price range from $100-1,500.

Image: Sigma

At around $8,000, the Sigma 300-800mm f/5.6 EX DG APO IF HSM is no bargain, but none of the telephoto primes currently available can beat its maximum focal length

Refracting Telescopes

Achromatic refracting telescopes were very widely used in the 19th and 20th centuries. The lenses in this type of telescope are usually referred to as objectives and are composed of two elements called the crown and the flint. An objective usually produces some degree of chromatic aberration, but this isn't usually a problem at focal ratios of 1:10 and more. One drawback of high-quality achromatic reflectors is their size – they are usually as long as their nominal focal length (i.e., a 1200mm telescope is around four feet long). Taking photos with this kind of gear is sure to provoke a fair amount of attention.

Light passing through a glass lens is refracted and split into its component colors to a degree determined by the curvature and quality of the glass in a process is known as dispersion. Combining two or more lenses made of different types of glass and with different curvatures reduces dispersion, which is why high-end photographic lenses are made up of many lenses arranged in multiple groups and why they are so much more expensive than telescopes.

Extra-low dispersion (ED) glass can be used to create three-element objectives with relatively short focal lengths and such good error correction that fringing is only visible at extremely high magnifications. The very complex processes used to manufacture these objectives often makes waiting lists for such devices several years long. Smaller telescopes with apertures of 100-130 mm and focal lengths of 530-820 mm cost between $6,500 and $10,000.

Even mass-produced telescopes were quite expensive until a few years ago, but Chinese manufacturers have completely changed the market, following a similar strategy to the one used by Japanese camera manufacturers in the 1960s. They began by copying successful designs and selling the results cheaply before going on to produce their own high-quality products. The reputation for poor quality that dominated the early days of Chinese objective manufacturing is now a thing of the past.

The extremely sharp detail rendition provided by ED glass at high magnifications and wide angles of view is ideal for observing nature as well as the heavens, but note that telescopes have much longer minimum focus distances than telephoto camera lenses with equivalent focal lengths.

Mirror telephoto lenses are a compact alternative to conventional super-telephotos

The People's Apo

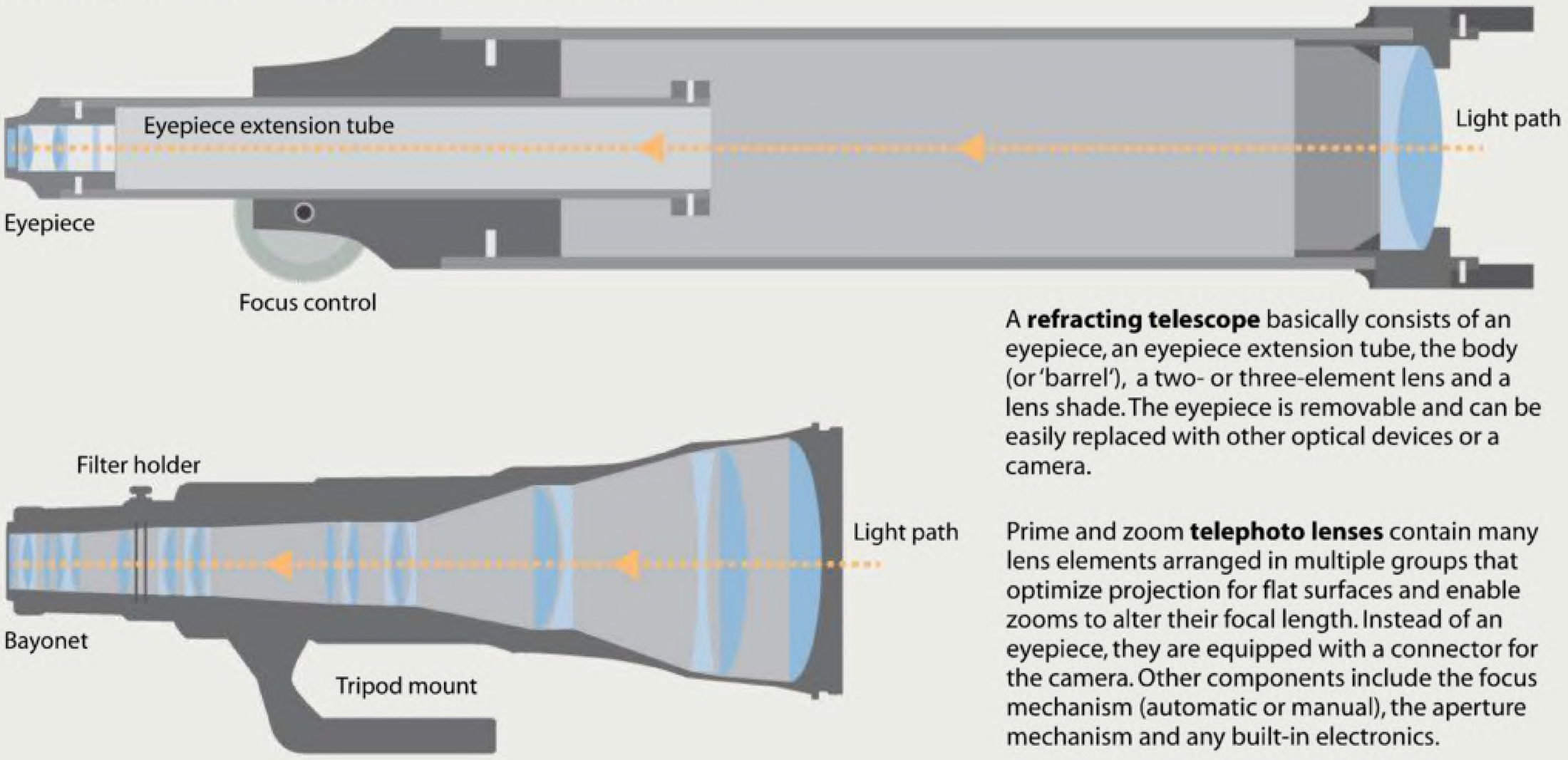
The story of the 'people's apo' describes developments in telescope manufacturing in China in a nutshell.

In 1980, the Synta Technology Corporation was founded in Taiwan with the aim of delivering components to telescope manufacturers around the world. With the help of Canadian investors, a Synta subsidiary was founded in mainland China in 1992 and began manufacturing telescopes that were rebranded with the Celestron and Tasco labels. In 1999, Synta introduced its own Skywatcher brand, which is also

A typical achromatic refracting telescope, the Vixen 80L has a focal length of 1200 mm and is almost four feet long

Comparing a Refracting Telescope with a Telephoto Lens

Refracting telescopes and telephoto lenses both utilize conventional lens elements, although a telescope is usually much longer than a telephoto lens with the same basic specifications.



A **refracting telescope** basically consists of an eyepiece, an eyepiece extension tube, the body (or 'barrel'), a two- or three-element lens and a lens shade. The eyepiece is removable and can be easily replaced with other optical devices or a camera.

Prime and zoom **telephoto lenses** contain many lens elements arranged in multiple groups that optimize projection for flat surfaces and enable zooms to alter their focal length. Instead of an eyepiece, they are equipped with a connector for the camera. Other components include the focus mechanism (automatic or manual), the aperture mechanism and any built-in electronics.

available elsewhere under the Vixen, Celestron, Orion and Acuter labels. Prices vary, sometimes due to the supplied accessories, but sometimes simply because of the pull of a particular brand. The Skywatcher brand has a good reputation and offers models from the entry-level MC 90/1250 mm ($255) to the high-end Esprit 120ED 120/840 mm for around $3,200.

In 2003, Synta introduced a compact ED refractor with an 80mm aperture, a 600mm focal length and a focal ratio of 1:7.5, which offers a sharp, high-contrast, pure-color image and minimal color errors. Thanks to its excellent quality and low price, it rapidly gained a reputation as the 'People's Apo', for the apochromatic lens elements it uses. Accessories are easily available so that it can be used as a telescope, a spotting scope or a camera lens.

The success of this model inspired other Asian manufacturers to follow suit, and companies like William Optics now produce a range of cheap telescopes with 65-90mm apertures. The original 'People's Apo' has now been updated and has a focal ratio of 1:10, which makes it easier to focus when used as a camera lens. More recent models are equipped with three-element 'triplet' objectives that correct optical errors even more effectively.

The Skywatcher ED80 is a compact 600mm ED refractor

Only simple modifications are required to convert a telescope into a spotting scope

Reflecting Telescopes

In 1680, Isaac Newton presented a telescope made using a spherically ground concave main mirror and a smaller secondary mirror that diverted the light reflected from the main mirror at a 90-degree angle. A Newtonian reflector telescope only requires a single spherical surface and reflects all light at the same angle without creating any chromatic aberration, according to the principle *angle of entry = angle of exit*.

Because the secondary mirror is located in the center of the main light path and partially **obstructs** the main mirror, telescope makers quickly came up with the idea of making a hole in the center of the main mirror through which the light from the secondary mirror can be reflected. Combined with a convex secondary mirror, this enabled the construction of a telescope that is much shorter than its own nominal focal length (see the illustration of the Cassegrain telescope below). Additional correcting lenses introduced into the designs of reflecting telescopes in the 1940s to reduce optical errors such as coma or vignetting and increase the field of view were named after their inventors. For example, a **Schmidt-Cassegrain** telescope has a relatively thin Schmidt corrector plate mounted at its front end, while a **Maksutov-Cassegrain** uses a thicker meniscus lens. Both designs produce little or no visible dispersion, so they provide pure-color reproduction. Extra mounting bars are unnecessary because the secondary mirror is mounted on the rear of the front element. Optical systems that mix mirrors and lenses are called **catadioptric** systems.

Unfortunately, the relatively simple design of a short reflecting telescope is not easily transferred to a photographic lens. To form an image on the film or sensor, the focal point in a camera lens has to be shifted rearward using a correcting element, which means that cheaper mirror lenses produce only average-quality images.

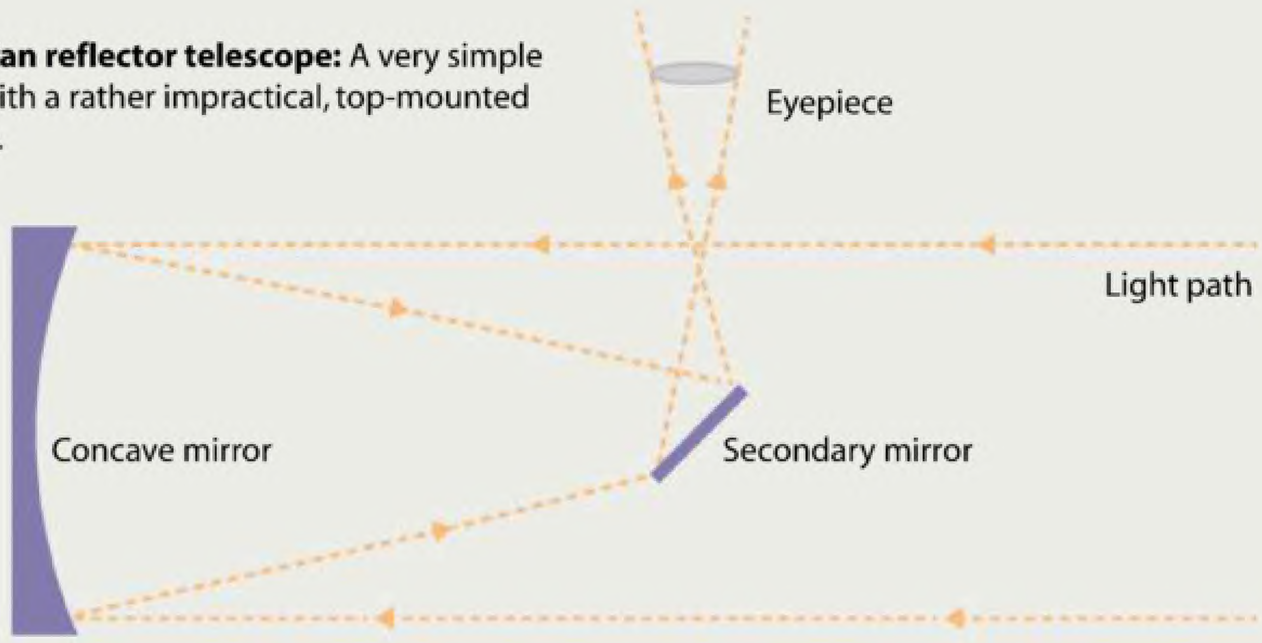
The Focusing Issue

In most catadioptric telescopes, focusing is achieved by means of a finely geared mechanism that moves the main mirror back and forth. Catadioptric camera lenses are focused using a system of two tubes and moving lens elements. Rotating the outer of the two tubes alters the distance between the groups of elements to change the focus setting. This system makes it quite difficult to locate the point of maximum sharpness, and even the tiniest deviations produce obvious blur.

Mirrors Used as Optical Elements

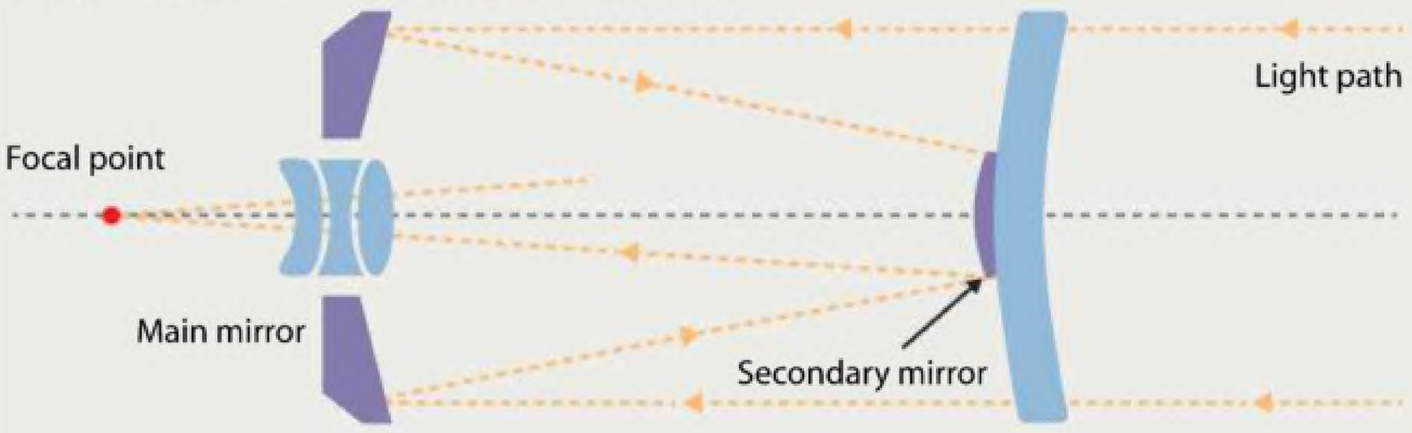
Leonardo da Vinci used the magnifying properties of mirrors to aid his astronomical observations. During the 17th century, astronomers Laurent Cassegrain and Sir Isaac Newton designed the telescope types that bear their names, both of which are still in use today.

Newtonian reflector telescope: A very simple design with a rather impractical, top-mounted eyepiece.



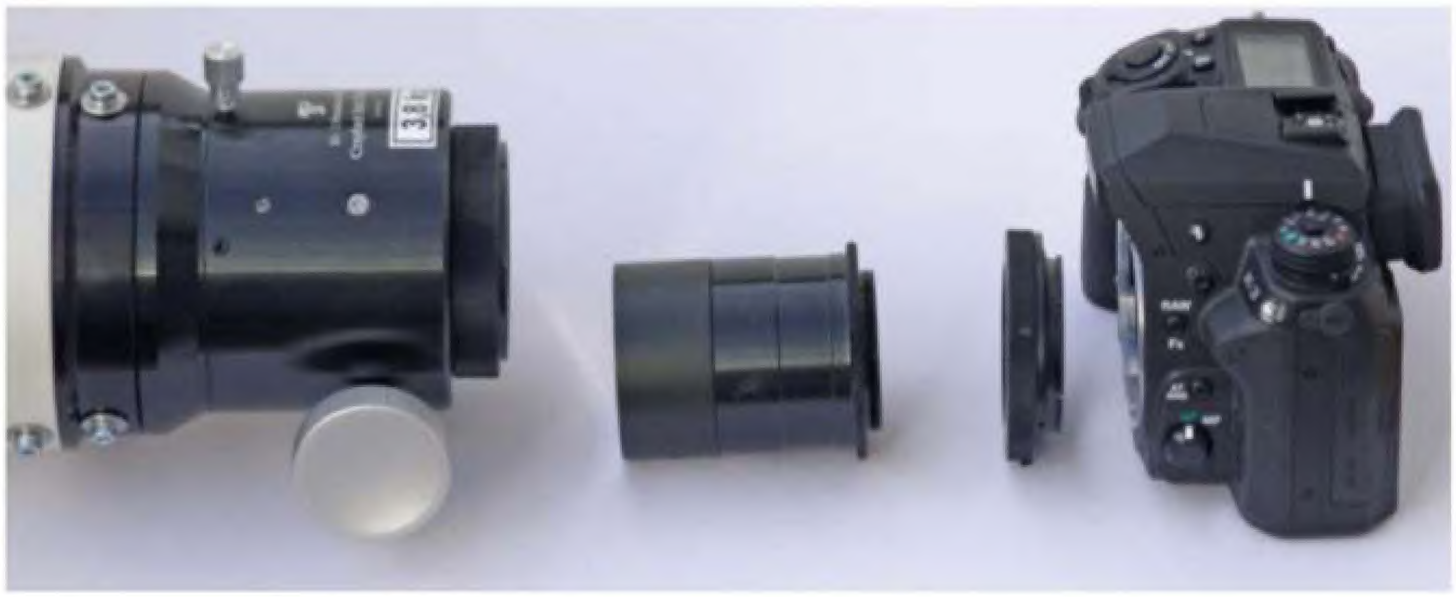
Cassegrain reflector telescope: The hyperbolic secondary mirror extends the focal length and makes the device smaller.

Photographic mirror lens: A similar design to the Cassegrain telescope with additional lenses to improve image quality for photographic purposes.



How Telescopes Work

While camera lenses produce an image that is optically corrected so that it is projected in sharp focus onto a plane surface, telescopes are designed primarily with observation in mind and usually project curved images. The human brain can interpret the non-plane image in a telescope without too much difficulty, but the same image is virtually useless if projected onto a flat surface such as a piece of photographic paper. However, used with the right accessories, telescopes can be converted into practicable photographic lenses. They have modular designs that make them much more flexible than conventional camera lenses, even if they are not designed to produce the best possible image for a specific type of camera. While camera lenses usually have a built-in lens connector, high-quality telescopes have more flexible connector systems, making it relatively simple for a **telescope** to double as a **spotting scope** or a **camera lens**.



To use a telescope with a DSLR, you need an eyepiece extension, a field flattener and a T2 adapter

Telescope or Spotting Scope?

Astronomers have it easy; they use their telescopes to observe the heavens only and do not require a plane projection or a laterally corrected image. All you need to utilize a telescope's optics is an **eyepiece**; focusing is achieved using a separate **eyepeice extension tube** that moves back and forth in relation to the telescope body. High-end

The diameter of the eyepiece extension tube is the most important metric for determining which type of sensor you can use to capture photos with a telescope. It needs to measure at least 2.5" if you want to use a full-frame camera without producing vignetting effects.

eyepiece extensions have finely geared sliding mechanisms that make it possible to focus more precisely. Manual focus is slower than autofocus but produces better results, and you can improve focusing accuracy in a telescope by purchasing a higher-quality eyepiece as an accessory. To use a telescope for terrestrial observation purposes (i.e., as a **spotting scope**) you need to add an **inverting prism** that flips the image so that it has the correct orientation when you view it. Reflex cameras have a roof prism or 'pentaprism' built into the viewfinder that performs the same function, so you don't need to use an inverting prism when using a telescope to take photographs. Although you cannot use your camera's autofocus system to focus an attached telescope, you can use trap focus functionality to ensure sharp focus. Trap focus allows you to manually focus and have the camera delay firing the shutter until an object is located in the focus range you have se. This system requires lenses with a wide maximum aperture and doesn't work for all subjects.

Use Reading Glasses if Necessary

The best way to aid manual focusing when using a telescope as a lens is to use the camera's monitor or the live view zoom function. However, even the finest focusing system and the highest-quality apochromatic lens elements don't help if you are unable to adequately evaluate the degree of sharpness on the monitor. If you are longsighted to a degree that doesn't require glasses in everyday situations, you should still invest in a $5 pair of reading glasses from a drugstore.

Using a Telescope as a Camera Lens

The main prerequisite for using a telescope as a **photographic lens** is an appropriate mounting adapter. A **T2 adapter** can be used to attach a telescope to most popular camera bayonets. The other thing you need is a **field flattener**, which produces an image that can be projected onto a plane surface. Mirror lenses for cameras have a flattener built in. A conventional telescope produces a spherical image that is projected by way of the objective, the eyepiece and the lens in your eye onto your (curved) retina, where it is interpreted by your brain. Because a curved image is no use in a photo, you need a field flattener to convert it into a form the human brain can make sense of. The field flattener is attached to the camera and inserted into the telescope's eyepiece extension tube. Some field flatteners are also designed to reduce the telescope's focal length and increase its aperture. For example, a 0.8 flattener/reducer combo transforms a 700m f/7 telescope into a 560mm f/5.6 telephoto lens.

Calculating Focal Length

Photographers need to learn some new terms when purchasing a telescope. The main reference value for a telescope is the diameter of its objective or the main mirror (in millimeters or inches), rather than the familiar focal length metric. Calculating focal length is easy – just multiply the two values. For example, for an 80mm f/6.5 telescope, 80 x 6.25 = 500 mm. Telescopes generally have a single, non-adjustable aperture setting.

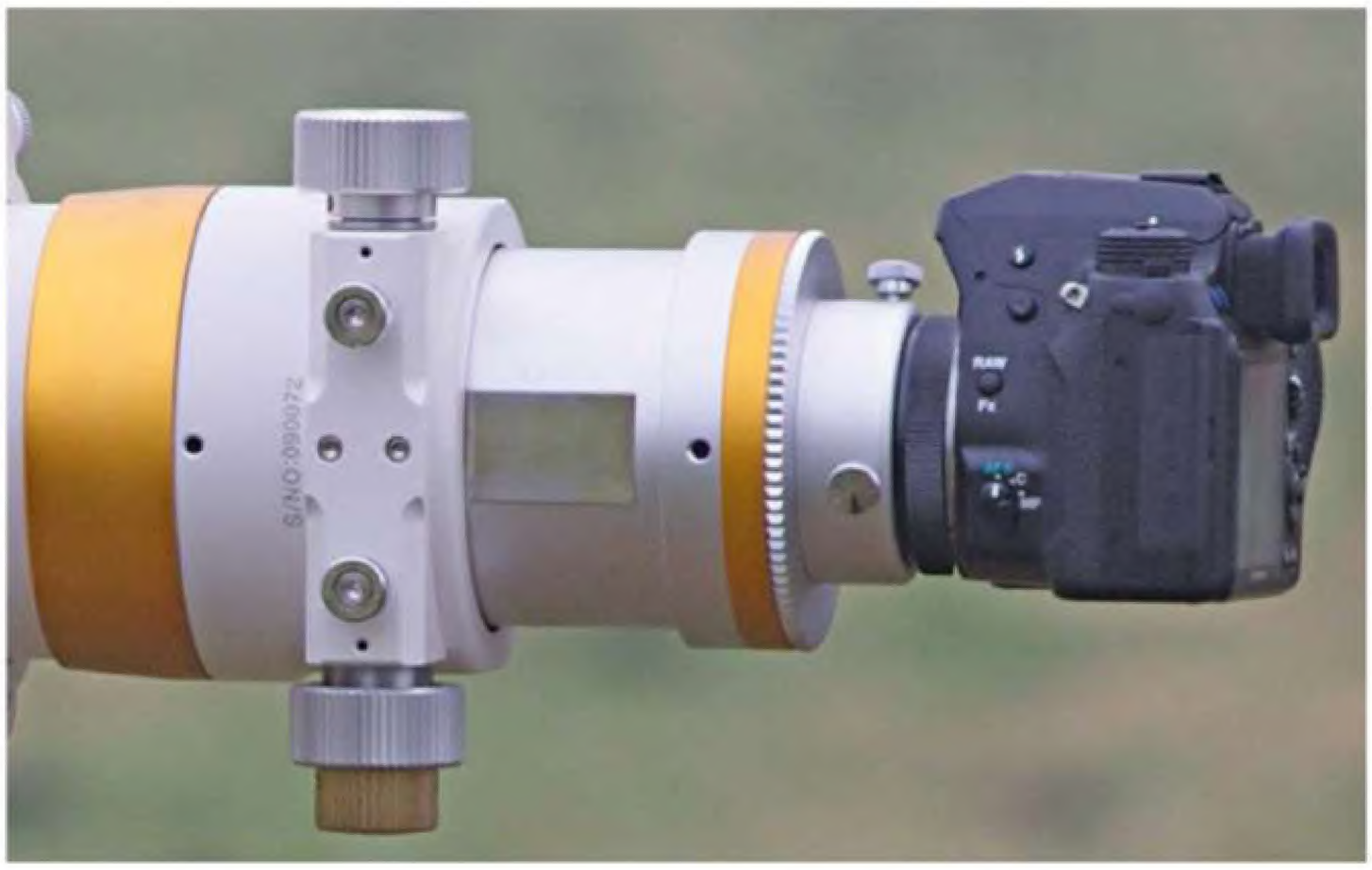
Eyepiece Diameters and Sensor Sizes

Another important telescope metric is the diameter of the receiving end of the eyepiece extension tube, which doesn't always match the end that you insert into the telescope. Adapters are available for connecting all popular sizes of extension tubes and eyepieces/focusers. The diameter of the extension tube (usually stated in inches) determines the size of camera sensor you can use without producing vignetting effects in your photos. A standard value in older telescopes is 1.25", but you need a diameter of at least 2" to produce clean photos with an APS-C camera, or 2.5" if you are using a full-frame camera. These are guide values only and can vary depending on the specific accessories you use – in other words, the specifications of a telescope don't necessarily reveal whether it is compatible with full-frame cameras.

Always check the effects a telescope produces with your camera before you buy. Currently, APS-C photographers have a broader choice than their full-frame colleagues, although there is an obvious trend toward telescopes with larger extension tubes. The broader the extension tube, the more stable it is and the heavier the camera it can support. Mirrorless system cameras are lighter than DSLRs and therefore easier to mount on a telescope.

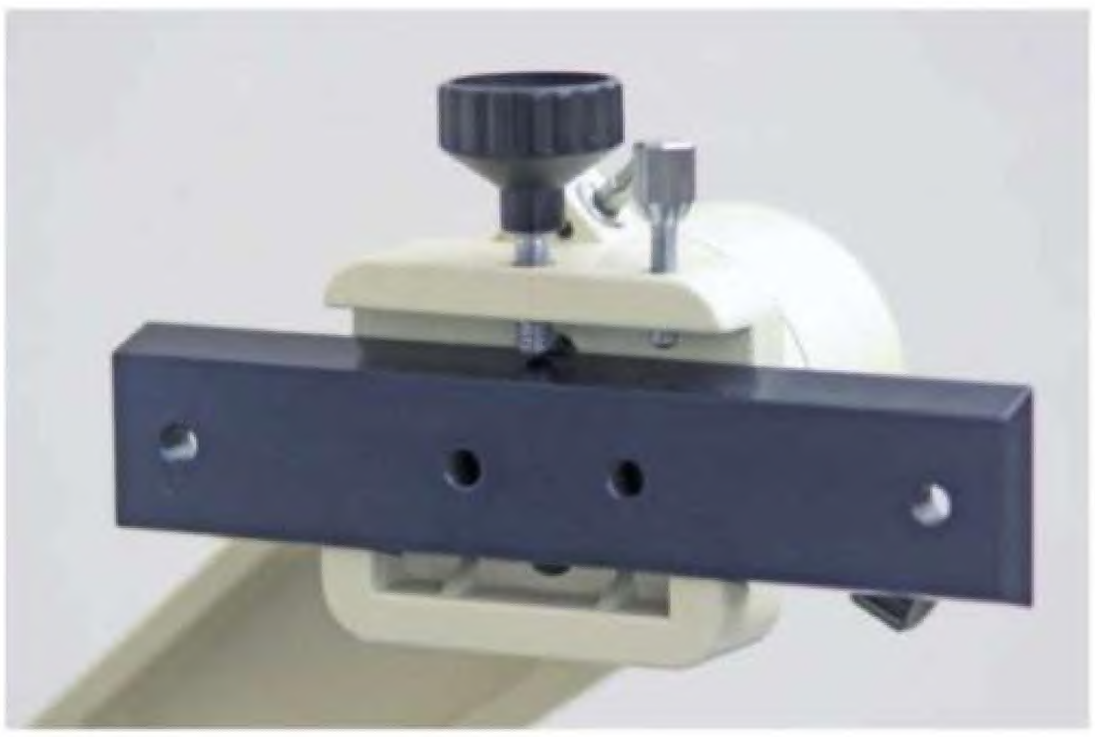
Photo Tripods Not Always the Best Choice

Touching or moving a camera fitted with a long lens produces visible shake that blurs images and makes it difficult to focus



A robust, high-end 2-inch William-brand focuser

GP rails are used to attach a telescope to its tripod.



An Ayo mount with a rail attached

accurately. High-quality telephoto lenses usually have a built-in tripod mount for mounting the camera/lens combo, which is then positioned by adjusting the tripod head. A simple photo tripod with a fluid-damped or three-way adjustable head is usually sufficient to support a compact telescope, but ball-head tripods are less suitable because they tend to tip unpredictably when used with telescopes. Photographers who use long lenses often use a tripod with a gimbal head, and these are often more practical for telescope use too. Of course, the lighter and more robust your tripod is, the easier it will be to carry, but a light tripod is less stable.

Telescope Mounts

Portability is less important than stability in a telescope mount, and 2000mm reflecting or 900mm refracting telescopes make very different demands of a tripod than a long telephoto camera lens. A telescope support doesn't need to change its position quickly and doesn't usually need to be lightweight. Stable aluminum telescope tripods start at around $100, while wooden models cost at least twice as much. In addition to the tripod itself, you also need a mount, which is the equivalent of the head in a photographic tripod.

Telescopes used for astronomical observations are usually equipped with a **parallactic mount** in which the main equatorial axis (which follows the rotation of the sky) is paired with a second perpendicular axis so that you only need to alter the position of one axis to follow the circular motion of the stars from east to west. A telescope is usually affixed to the tripod using solid metal swallowtail or prism-shaped rails. One of the most widely used rails is the **GP (Great Polaris) series** and its variants, introduced by Vixen in the 1980s and still an industry standard. Small (400-600mm) refracting telescopes with apertures of up to 80mm are often mounted using a smaller version of the GP rail that has its own tripod thread. Equatorial mounts are not suitable for terrestrial photographic purposes.

The best choice for telescope photography is an **altazimuth** mount. This works similarly to a two-axis photo tripod head, and the camera/telescope combo is positioned by moving the telescope. The prism-shaped rail makes it possible to balance the unit and rotate it in all directions while ensuring that it stays put once you have positioned it.

A **sighting aid** is often necessary for locating the rough position of a subject when you use a telescope with an extremely long focal length. Once you have found your target's approximate position, you can fine-tune the position of your main telescope and adjust focus. If you work without a sighting aid with a telescope with a focal length of 1000mm or more, you will waste a lot of time searching.

The Cost of Accessories

The body of a telescope alone is not much use to anyone – you have to purchase a number of accessories to turn it into a usable telescope, spotting scope or photographic lens. However, high-end equipment is expensive, so if you are just starting out, you are probably better off purchasing a ready-made kit with all the bits and pieces you need to get up and running. Advanced users will, of course, prefer to put together their own setup using their own choice of parts. The table on page 94 provides some guide prices for entry-level and high-quality telescope gear.

Equalizing Temperature

You need to take the expansion and contraction of the materials involved into account when using a telescope with a long focal length. Lenses and mirrors are mounted in their sleeves using tensioning rings that exert pressure and affect the refractive and reflective behavior of the components. If the top of a telescope is in the sun but its underside is in the shade, the temperature difference will cause distortion in the optical system and air turbulence within the body. Always use your telescope in the shade if you can and, if you move a telescope from a warm room into the fresh air, give it time to adapt before setting it up and making observations.

How We Tested

The plateau at the top of the 99-meter (325-foot) Drachenberg ('kite mountain') in Berlin provides great views of the city below and is ideal for testing long lenses and telescopes. The radio tower is 2 km (1.24 miles) away and the television tower at Alexanderplatz is 11 km (6.8 miles) in the distance. Looking at the scene through binoculars, the buildings in between appear very close together and distant objects simply disappear into the increasing haze. The radio tower presents a filigree metal structure against a pale blue background and reliably exposes any chromatic aberrations produced by optical systems.

The famous radio tower in Berlin, photographed using a 200mm (equivalent) lens on an APS-C camera

A Clear View Means Clear Photos

On a clear day, it is the resolution of the camera sensor, not the quality of the telescope's objective, that limits the quality of telescope images. Our tests took place over a period of several weeks, so we were not always able to shoot in identical conditions. To test the real power of telescopes with focal lengths greater than 900 mm you need excellent conditions with really clear air, which is seldom the case in Berlin. Genuinely clear air can only be found on islands way out at sea or above the clouds. The differences the conditions made from day to day are obvious in the amount of flicker in our test shots and the amount of visible background detail. Flicker is a two-edged sword: some hate it, while others like to use it as a deliberate stylistic device.

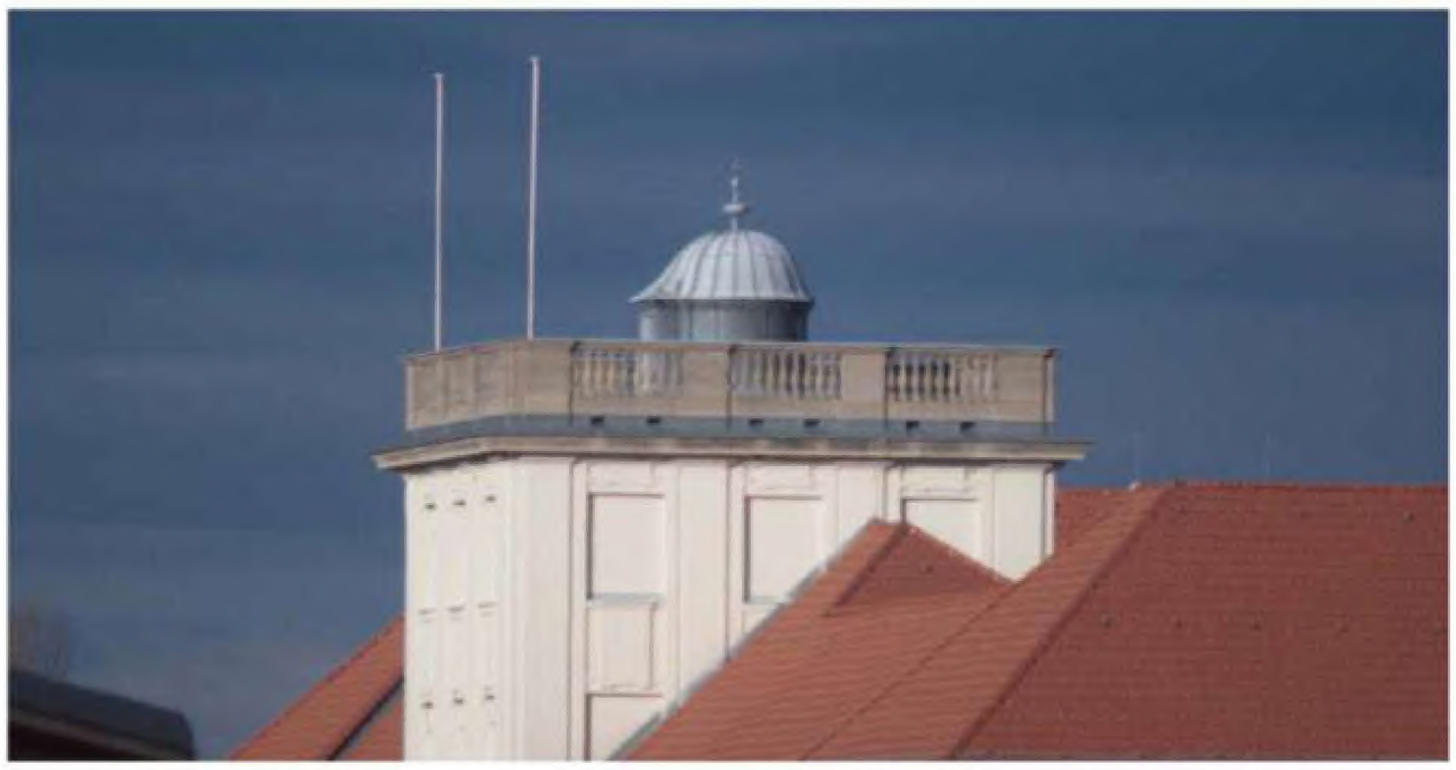
Captured from the same position using a 600mm Skywatcher ProED 80 (~900 mm equivalent full-frame focal length)

Artifacts on Flagpoles

Our other test involved capturing images of two flagpoles on the roof of a building 600 m (about a third of a mile) distant. Again, because our test telescopes weren't all available on the same day, we had to shoot in varying conditions, and the sharpness and the degree of artifacts in our images varied accordingly. In spite of these inconsistencies, our images clearly show the differences in performance produced by our test candidates. All test shots were captured using Pentax K-3 and K-7 cameras with APS-C sensors and are included with this issue's online content.

A magnified detail from the image captured using the Skywatcher

Telephoto Lens Test Results



The fringing artifacts produced by the Bower 500mm f/8 are obvious in the uncropped image

This detail confirms the heavy fringing at f8

Stopping down to f11 reduces the severity of the artifacts

The image quality produced by the 800mm Samyang mirror lens isn't spectacular, even in the uncropped view

This detail crop underscores the lack of sharpness

The **Bower 500m f/8** is a cheap manual-focus telephoto lens without an automatic aperture diaphragm. Although not stellar, its performance is perfectly acceptable for the price. High-contrast edges show obvious fringing artifacts whose severity also depend on the prevailing weather conditions.

The sharpness produced by the **Samyang 800mm f/8** mirror lens is generally very poor; the images should have turned out better in spite of the hazy weather. The focus ring is difficult to position precisely and the lens is only good for low-end use.

The **Sigma 150-500m f/5-6.3** is a versatile telephoto zoom at an affordable price. Its optical quality is acceptable but variable, and if you shoot at maximum aperture at the long end of the zoom range, you won't be utilizing its full potential. Image quality is much better stopped down, which means that its weaknesses are unfortunately most prevalent where they are most critical to its real-world performance.

The **Tokina 80-400mm f/4.5-5.6 AT-X** is designed for use with full-frame cameras. With a long end of 'only' 400mm, it is quite short in relation to most of the other lenses we tested. Images captured using long telephoto zooms often lack sharpness and contain fringing artifacts, so the Tokina's basic design parameters promise better-than-average image quality. In reality, the results it produced were only acceptable and didn't noticeably improve when stopped down.

The **Samyang 650-1300mm f/8-16** (also available under the Rokinon and Bower brands) has a T2 mount and manual focus. The working aperture is not adjustable but becomes smaller as you zoom. To zoom, you have to release a locking ring and manually extend the telescopic lens barrel. Build quality is poor and the lens actually bends at its maximum extension (see the photo opposite). Image quality is correspondingly meager. If you are looking for a cheap ultra-long lens, the fixed-focal-length 500mm Bower is a much better bet.

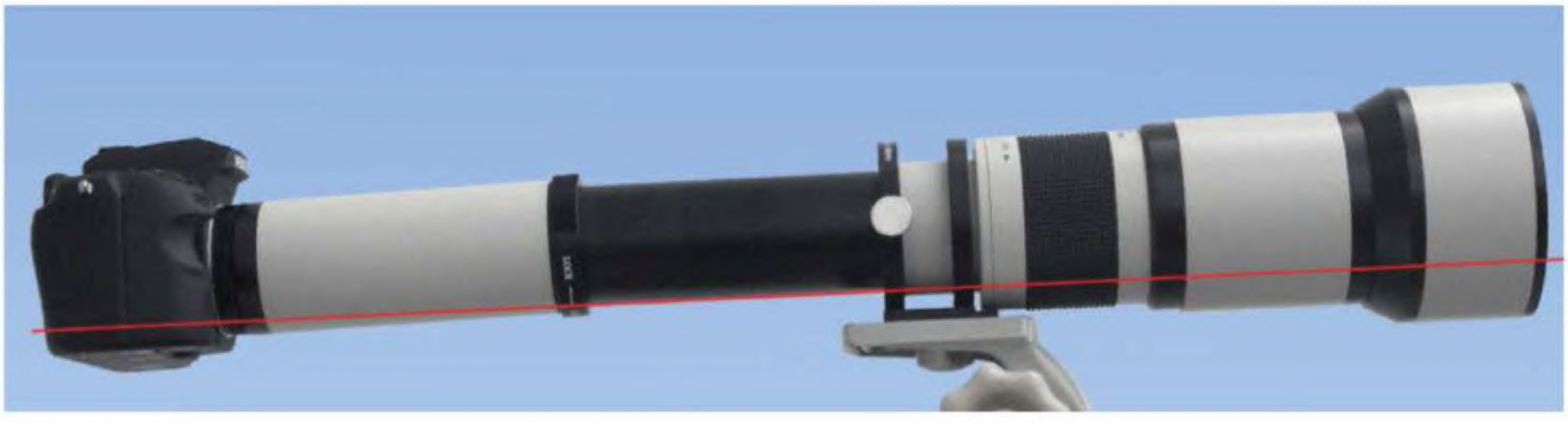
The Sigma 150-500mm f/5-6.3 is an affordable telephoto zoom with great specifications

Captured at f8

Captured at f11

The detail rendition produced by the Samyang 650-1300mm f/8-16 is noticeably poor, even in the uncropped image. The overall effect is blurry and unsharp.

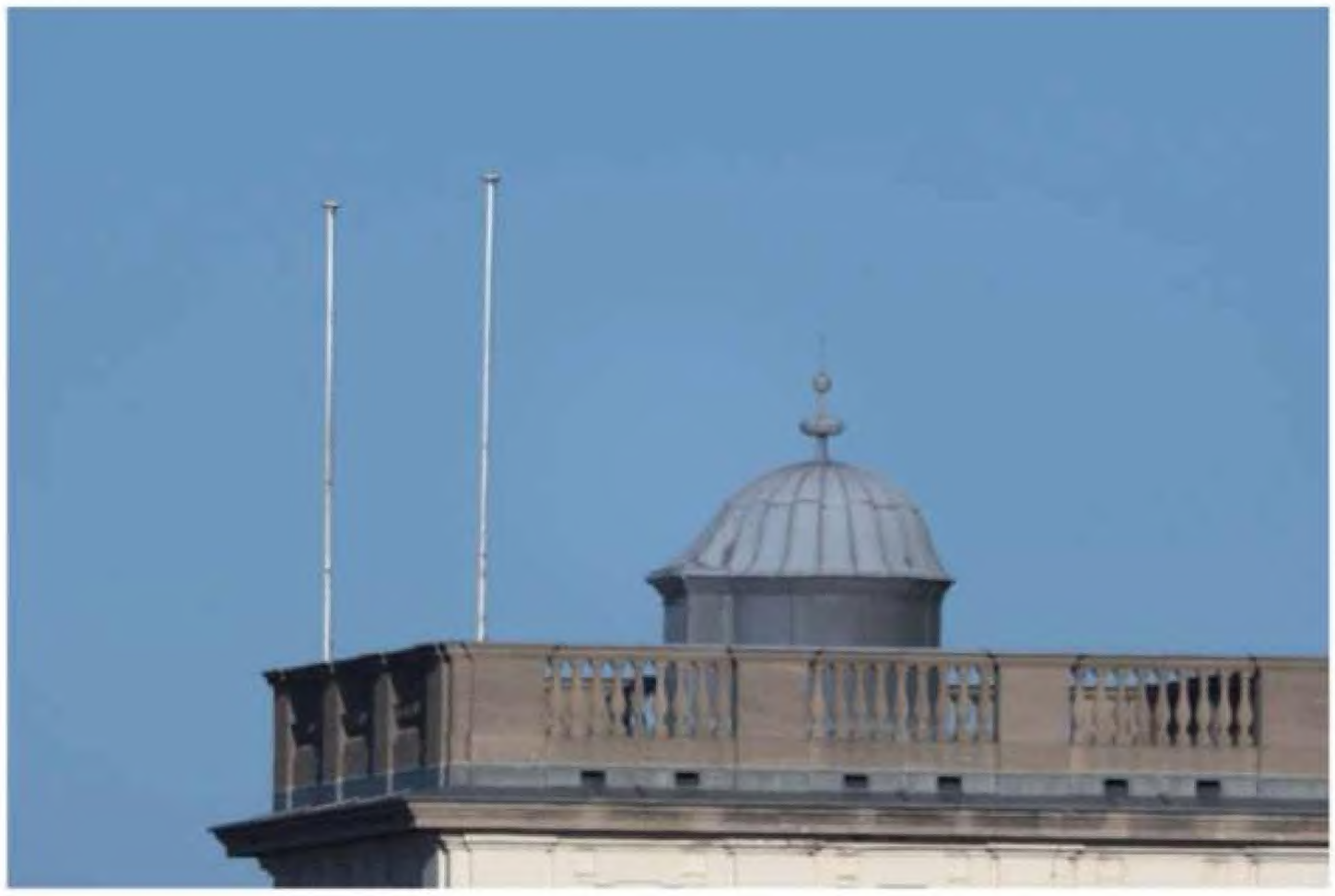
The detail crop shows just how poor its performance is



The 650-1300mm f/8-16 Samyang costs just $240, but its build quality matches the price. The lens barrel actually bends when it is mounted at full extension on a tripod (the straight red line highlights the issue).

Refracting Telescope Test Results

The Acuter ED90/900mm is an impressive sight when attached to a DSLR but its size makes it unstable in windy situations



ED glass elements make the Acuter more expensive than the Skywatcher Evostar 90/900 EQ2, which otherwise has the same specifications

ED elements, which produce fewer fringing artifacts than conventional achromatic elements, are a worthwhile investment

The **Skywatcher AC 90/900 EvoStar** is an entry-level achromatic telescope with a 90mm aperture and 900mm focal length. Overall image quality is good, although it does produce some fringing. At around $250 in a kit with a tripod, an azimuth mount and an eyepiece, it is great value for money. It is not designed for use with high-resolution camera sensors and the supplied extension tube is too narrow for effective use with a full-frame camera but is fine when used with APS-C models. The tube can be swapped for a broader one, but the accessories involved cost more than the telescope itself. The supplied tripod is stable enough to use in light winds.

The **Acuter Apo ED 90/900** (a rebadged version of the Skywatcher APO ED-90 Pro) has the same basic specifications as the entry-level Skywatcher EvoStar 90/900, but its ED glass elements are more expensive and have a lower refractive index than their conventional achromatic counterparts. The more expensive glass makes an obvious difference, as there is virtually no visible fringing and much better overall sharpness. Complete with its lens shade, this telescope is more than three feet long when mounted on a DSLR and represents the limits of practical usability. The eyepiece cannot be rotated, so it is worth investing in a more expensive one to enable you to switch quickly between portrait and landscape formats. If you add a 2.5-inch eyepiece, this telescope is even compatible with full-frame cameras.

The **Omegon Photography Scope ED 72/432 mm** is 16 inches long and weighs just over 4 lb, which is quite compact for a refracting telescope. It has a focal length of 432 mm, a built-in lens shade and a 2-inch eyepiece extension tube. It also has a built-in 3/8" tripod thread in the form of a GP-style rail that is compatible with many astronomical tripod mounts. The body has a broad, easy-to-use focus ring. This a great vacation telescope, as it is specifically designed for use as both a spotting scope and a camera lens. The optional 2-inch field flattener is designed for use with APS-C cameras but is not compatible with full-frame models.

The **Skywatcher ProED 80 mm** is also sold as the Vixen ED80 SF. Its 600mm focal length represents a good compromise between range and handling. It produces very good image quality indeed, with no visible fringing

The Skywatcher ProED 80 produces image quality that is good enough for making enlarged crops

The 600mm focal length of the Skywatcher ProED 80 represents the ideal compromise between maximum focal length and practicable handling.

and excellent photographic attributes when it is used with a 2-inch field flattener and an APS-C camera. Its quality is sufficient for use with full-frame cameras too, although the supplied eyepiece extension tube is too small to accommodate the required 2.5-inch field flattener, which costs around $300 extra.

The Omegon's detail crop shows no fringing artifacts at all

The Omegon Photography Scope is a compact refracting telescope/spotting scope with a medium focal length of 432 mm

The Omegon Photography Scope is designed for use as a telescope, a spotting scope and telephoto lens and is compact enough for vacation use

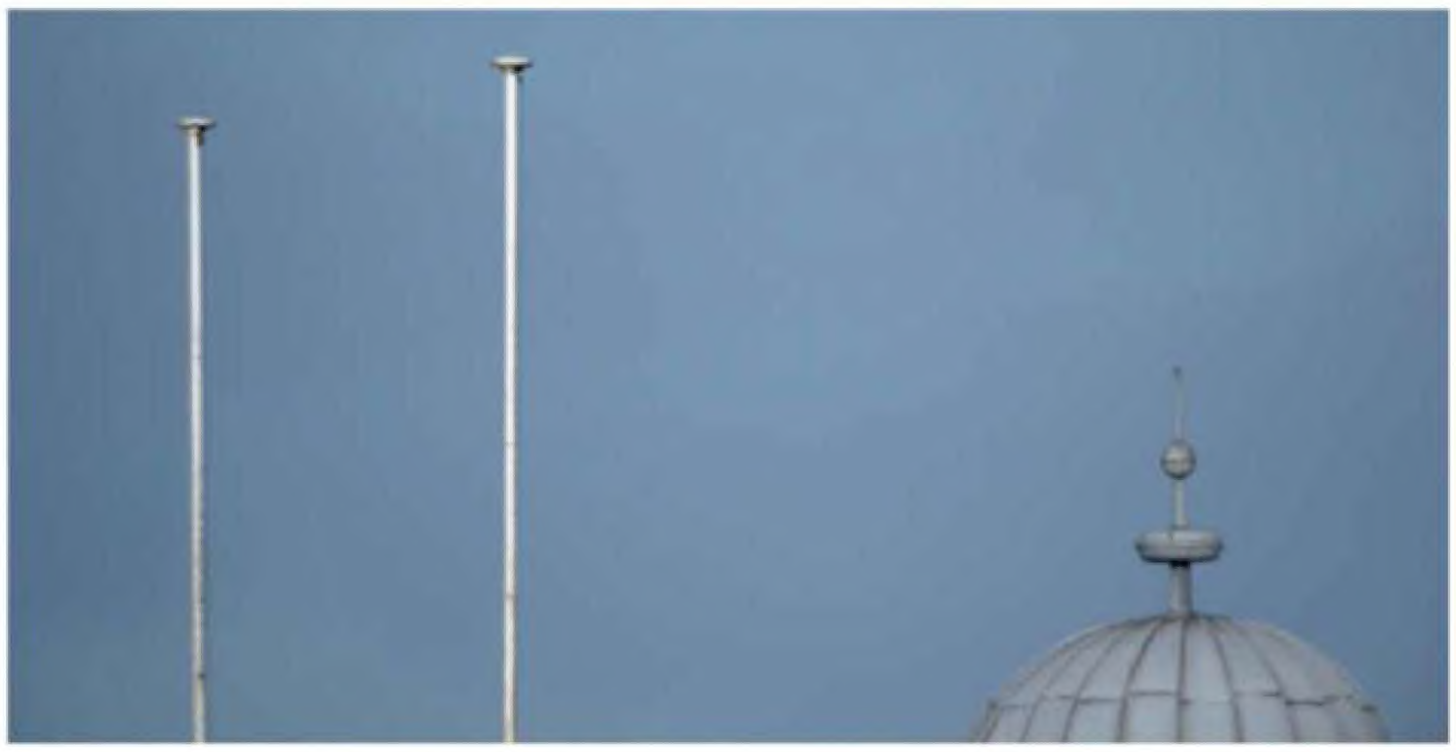
Reflecting Telescope Test Results

The Ritchey-Chrétien's focal length of 1370 mm has a strong telephoto effect, especially when used with a crop-format APS-C camera

Image quality in our detail crop is very good. At these focal lengths, you simply have to accept a certain degree of flicker in your images.

The Ritchey-Chrétien 6" f/9 telescope can also be used as an ultra-long 1370mm lens for APS-C cameras provided, of course, that the prevailing conditions provide sufficient visibility – otherwise flicker and haze will obscure too much detail. The telescope itself weighs 5.4 kg (12 lb), making it a stable, solid, easy-to-focus unit when used in combination with a mount like the Skywatcher HDAZ. The short body of a reflecting telescope makes it less susceptible to unwanted movements due to wind than the longer bodies inherent in refracting designs. Detail rendition in the Ritchey-Chrétien is great, but its focusing mechanism is not based around the main mirror, so its minimum focus distance is an unusually long 100 meters. You can only focus on closer subjects if you use additional eyepiece extensions. Additionally, the front end of its body is open to the atmosphere, making it all too easy for dust to settle on the mirror. This particular model shows slight vignetting when used with full-frame cameras.

The Celestron C6 is a catadioptric Schmidt-Cassegrain reflecting telescope with a focal length of 1500 mm. Used with a field flattener, it shows good detail reproduction in most of an APS-C frame, although our test model produced obvious sharpness drop-off toward the corners. It is fine for photographing nature subjects, but it produces too much distortion for architectural use. It is also great for shooting video footage of distant events such as sunsets but, as with all other ultra-long lenses and telescopes, you need well-nigh perfect weather conditions to achieve usable results.



With is APS-C equivalent focal length of around 2250 mm, the Celestron C6 captures only details of very distant subjects

The image quality produced by the Celestron C6 is generally very good, although quality drop-off at the edges of the frame and its tendency to distort make it less suitable for architectural shoots

The Celestron C8 has an enormous focal length of 2000 mm at a focal ratio of 1:10. It measures nine inches across and weighs 5.7 kg (12.5 lb) but is nevertheless compact in view of its powerful specifications. One of the best-selling models of the last 40 years, the C8 can, under the right conditions, be used to shoot sharp photos. Its focuser is sufficiently sensitive to make precise focusing possible for extremely distant subjects, but image quality takes a dive as soon as visibility is less than perfect. This is a specialist device with limited uses and shows its real strength in clear mountain air above the cloud line. Of course, you can use the flicker effects that a lens like this produces creatively to capture mirage-like images of distant subjects. These can add drama to video clips too.

The only way to line up a lens/telescope with a 2000mm focal length is by using a sighting scope, and a stable tripod with a high-end mount is essential if you want to retain precise control of your settings.

The 6-inch Ritchey Chrétien has a focal length of 1370 mm and the 'washing machine' look typical of this class of reflecting telescope

The 1500mm Celestron C6 can only be used for taking photos under ideal visibility conditions

With a focal length of 2032 mm, the Celestron C8 represents the limits of practicable terrestrial photography using a telescope as a lens

Conclusions

Photography using telescope objectives is not a new idea, and twin-element achromatic camera lenses were available from a range of manufacturers as late as the 1980s. Since then, the quality of mass-produced telescopes has improved enormously, even as prices have kept falling. Today's compact models with ED lenses, wide eyepiece extensions and finely adjustable focusers are a lot easier to use than earlier models and are rapidly gaining popularity as an alternative to dedicated telephoto lenses.

Most photo dealers don't stock telescopes, but telescope stores often carry a range of adapters and accessories for attaching telescopes to cameras. Of course it is not as straightforward or effective to use an adapted telescope as is to use a dedicated lens designed for use with a specific brand of camera. On the other hand, in times in which many photographers purchase a new camera (or even a complete new system) every couple of years, adapters offer such flexibility that a telescope often sticks around longer than a telephoto lens might.

There is a wide choice of value 500-900mm refracting telescopes that can be used as spotting scopes and camera lenses too, although you will usually have to do without autofocus in this segment. But remember, the

The uncropped image produced by the 2000mm Celestron C8 is of similar quality to the enlarged crops we produced using camera lenses

For this kind of focal length, the Celestron C8 produced surprisingly good image quality, especially in the center of the frame

longer your lens, the more difficult it will be to handle and the more robust your tripod and mount will need to be. The limits of practical everyday use lie in instruments with 120mm objectives and 900mm focal lengths; anything above this is more of a pastime for patient hobbyists. You can generally achieve better image quality with high-quality refracting telescopes and field flatteners than with any type of reflecting telescope.

Reflecting telescopes are the better choice when you require ultra-long focal lengths of 1000 mm or more. They have relatively large apertures and are compact but tend to suffer more from edge

Comparing Camera Lenses and Telescopes

Manufacturer	Model	Focal Length	Design	Close Focus Distance	Autofocus	Maximum Aperture	Adjustable Aperture
Fixed Focal Length Lenses							
Bower/Neewer	Telephoto	500 mm	Refractor	12 m	–	f/8	✓
Samyang	Mirror telephoto	500 mm	Mirror/Refractor	2.0 m	–	f/6.3	–
Nikon	AF-S NIKKOR	600 mm	Refractor	5.0 m	✓	f/4	✓
Samyang	Mirror telephoto	800 mm	Mirror/Refractor	3.5 m	–	f/8	–
Nikon	AF-S NIKKOR VR	800 mm	Refractor	5.9 m	✓	f/5.6	✓
Canon	EF L IS USM	800 mm	Refractor	6.0 m	✓	f/5.6	✓
Sigma	EX DG HSM	800 mm	Refractor	7.0 m	✓	f/5.6	✓
Maksutov	Rubinar 1000	1000 mm	Mirror/Refractor	25 m	–	f/10	–
Zoom Lenses							
Sigma	DG OS HSM	120-400 mm	Refractor	1.5 m	✓	f/4.5-5.6	✓
Sigma	DG OS HSM	150-500 mm	Refractor	2.2 m	✓	f/5-6.3	✓
Sigma	APO EX DG	200-500 mm	Refractor	2-5 m	✓	f/2.8	✓
Tamron	Di VC USD	150-600 mm	Refractor	2.7 m	✓	f/5-6.3	✓
Sigma	Contemporary DG OS HSM	150-600 mm	Refractor	2.8 m	✓	f/5-6.3	✓
Sigma	Sports DG OS HSM	150-600 mm	Refractor	2.6 m	✓	f/5-6.3	✓
Sigma	EX DG HSM	300-800 mm	Refractor	6.0 m	✓	f/5.6	✓
Opteka	Zoom Telephoto	420-800 mm	Refractor	2.0 m	–	f/8.3-16	–
Samyang	Pro T2	650-1300 mm	Refractor	5.0 m	–	f/8-16	–
Telescopes							
Omegon	Photography Scope	432 mm	Refractor (ED/Doublet)	8.6 m[1]	–	f/6	–
Skywatcher	Evostar 80ED Pro	600 mm	Refractor (ED/Doublet)	12 m[1]	–	f/7.5	–
TS	TSAPO906	600 mm	Refractor (ED/Triplet)	12 m[1]	–	f/6.7	–
Skywatcher	AC 90/900	900 mm	Refractor (Achromat/Doublet)	18 m[1]	–	f/10	–
Skywatcher	90ED Pro	900 mm	Refractor (ED/Doublet)	18 m[1]	–	f/10	–
GSO	Ritchey-Chrétien 152	1370 mm	Mirror/Refractor	100 m[1,2]	–	f/9	–
Celestron	C6	1500 mm	Mirror/Refractor	30 m[1]	–	f/10	–
Celestron	C8	2000 mm	Mirror/Refractor	40 m[1]	–	f/10	–

[1] The closest focus distance depends on the type of flattener, camera, eyepiece extension tube and any additional extensions, and is thus variable in telescopes.
In the absence of manufacturer's data we calculated our values using the generally accepted formula *(focal length/1000) × 20 = close focus distance*
✓ included – not included

weakness. Really bright reflecting telescopes often produce severe image errors, which is why we stuck to models with medium apertures for this test.

Regardless of the specifications of the lenses involved, weather conditions play a crucial role in reproduction quality at these focal lengths. Air turbulence, dust and atmospheric haze all limit the practical usefulness of ultra-long lenses, although if used deliberately as stylistic devices, they can add drama and individuality to your photos and videos.

At the end of the day, telescopes play an important role in covering the 400-900mm focal length range, which is largely ignored by brand-name camera lens manufacturers, so you can purchase highly effective substitute lenses quite cheaply

If, however, you are simply after the longest lens you can lay your hands on, reflecting telescopes are the answer. With focal lengths measured in meters rather than millimeters, they quite literally open up a whole world of new photographic horizons. (sts)

Ultra-long focal lengths produce flicker effects that will give your images a mystical, mirage-like feel

	Sensor (APS / FF)	Diamter	Length	Weight	Tripod Thread	Price (body)	Price (T2 Adapter)	Field Flattener	Mount	Total Price
	✓ / ✓	7.0 cm	31.5 cm	0.7 kg (1.5 lb)	Built in	$99	$25	Built in	–	$124
	✓ / ✓	9.5 cm	12.0 cm	0.66 kg (1.45 lb)	Not available	$150	$25	Built in	–	$175
	✓ / ✓	16.6 cm	44.5 cm	5 kg (11 lb)	Built in	$9,000	–	Built in	–	$9,000
	✓ / ✓	11.1 cm	11.3 cm	0.95 kg (2.1 lb)	Not available	$200	$25	Built in	–	$225
	✓ / ✓	16.0 cm	46.1 cm	4.6 kg (10.1 lb)	Built in	$18,000	–	Built in	–	$18,000
	✓ / ✓	16.3 cm	46.1 cm	4.5 kg (9.9 lb)	Built in	$13,000	–	Built in	–	$13,000
	✓ / ✓	15.6 cm	52.1 cm	4.9 kg (10.8 lb)	Built in	$6,700	–	Built in	–	$6,700
	✓ / ✓	12.1 cm	24.8 cm	2.3 kg (5 lb)	Built in	$500	$25	Built in	–	$525
	✓ / ✓	9.2 cm	20.3 cm	1.75 kg (3.9 lb)	Built in	$999	–	Built in	–	$999
	✓ / ✓	9.4 cm	25.2 cm	1.91 kg (4.2 lb)	Built in	$1,069	–	Built in	–	$1,069
	✓ / ✓	23.6 cm	72.6 cm	15.7 kg (34.6 lb)	Built in	$26,000	–	Built in	–	$26,000
	✓ / ✓	10.5 cm	25.7 cm	1.95 kg (4.3 lb)	Built in	$1,100	–	Built in	–	$1,100
	✓ / ✓	10.5 cm	26.0 cm	2.86 kg (6.3 lb)	Built in	$1,089	–	Built in	–	$,089
	✓ / ✓	12.1 cm	29.0 cm	2.86 kg (6.3 lb)	Built in	$1,999	–	Built in	–	$1,999
	✓ / ✓	15.6 cm	54.4 cm	5.88 kg (13 lb)	Built in	$7,999	–	Built in	–	$7,999
	✓ / ✓	7.0 cm	32.0 cm	0.7 kg (1.5 lb)	Built in	$150	$25	Built in	–	$175
	✓ / ✓	10.5 cm	46.3 cm	2 kg (4.4 lb)	Built in	$240	–	Built in	–	$240
	✓ / –	9.0 cm	39.5 cm	2 kg (4.4 lb)	GP rail	$700	$25	$300[3]	–	$1,025
	✓ / ✓[4]	11.5 cm	58 cm	2.5 kg (5.5 lb)	Built in	$700	$25	$300[3]	–	$1,025
	✓ / ✓	11.6 cm	50 cm	4 kg (8.8 lb)	GP rail	$1,600	$25	$300[3]	$330	$2,255
	✓ / –	11.5 cm	92 cm	2.5 kg (5.5 lb)	GP rail	$250	$25	$300[3]	built-in	$575
	✓ / ✓[4]	11.5 cm	92 cm	3.2 kg (7.1 lb)	GP rail	$650	$25	$300[3]	$330	$1,305
	✓ / –	19.1 cm	50 cm	5.4 kg (11.9 lb)	GP rail	$500	$25	$300[3]	$330	$1,155
	✓ / –	18.0 cm	37.5 cm	3.7 kg (8.2 lb)	GP rail	$600	$25	$300[3]	$330	$1,255
	✓ / ✓	23.0 cm	45.0 cm	5.7 kg (12.6 lb)	GP rail	$950	$25	$300[3]	$330	$1,605

[2] The focuser in this model does not move the main mirror, so shorter close focus distances can only be achieved using eyepiece extensions.
[3] Price for a 2" field flattener suitable for use with APS-C sensors. Full-frame-compatible (2.5" and larger) flatteners usually cost around $70 more.
[4] Only available with a larger replacement eyepiece tube for around $300 more.

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In This Article

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Raw Retouching

Raw converters are rapidly turning into full-fledged image-processing applications that not only develop the colors in raw image files but also enable you to selectively edit and fine-tune tones and individual details. Now that complex retouching has become part of the raw conversion process, we decided to find out which of the today’s popular raw converters are really up to the job.

Every raw image processing workflow begins with development and the application of a set of basic global adjustments that affect the entire image. These are usually changes to colors (white balance, color casts, etc.) or tonal values (exposure, brightness, contrast, etc.). The current trend is toward tools that enable you to apply such adjustments selectively at the raw conversion stage, which is logical when you consider that the equivalent analog darkroom techniques (dodging and burning) have always been part of every photographer's basic toolkit.

Contemporary raw converters allow you to adjust exposure, color temperature and saturation selectively and reduce unwanted effects such as noise artifacts. Depending on the software you use, such adjustments are applied using either a brush or vector-based selections.

Additional tools that used to be the preserve of dedicated image-processing applications are being added all the time, and you can now use your raw converter to eliminate red-eye effects, replace unwanted objects with context-sensitive pixels and much more besides.

Theoretically, you can now perform your entire image-processing workflow – from development to fine-tuning – using a single application, and the familiar task of handing over your developed images to the image-processing program of your choice for final tweaking is rapidly becoming obsolete. The following pages check out whether the theory is backed up by software that really can 'do it all'.

The Path from Destructive Processing to Raw Retouching

There is such a huge range of workflow options available that it can be quite confusing when you are trying to decide which approach to take. The differences between destructive and non-destructive tools and applications aren't always obvious, even though the practical differences are relatively easy to explain.

Destructive Image Processing

Early image-processing tools were all destructive, i.e., they don't wreck the composition, but they irreversibly alter the pixels in the original image file. If you don't make a backup copy of an image before making destructive adjustments, the original will be lost forever the moment you save your changes.

Although Adobe's powerful *Photoshop* package has supported a non-destructive workflow for many years, some of its tools are still based on destructive processes. For example, if you use a Curves adjustment to alter image contrast, its effects are applied directly to the pixels that make up your image and saving the results permanently alters the image file.

Non-destructive Processing

Non-destructive processing eliminates this issue so all your adjustments can be readjusted or undone at any time (even when you close and re-open a file) and the original image file remains intact.

Non-destructive processing ics constantly increasing in its sophistication. *Photoshop* has supported layers functionality since the release of PS3, and PS4 added the even more powerful adjustments layers. Smart Objects were introduced with the CS2 version of the program.

- **Layers** enable you to save multiple versions of an image in a single file.

- **Adjustment layers** enable you to save adjustment parameters without actually altering the original pixels. Adjustment layers contain only instructions that tell the program which changes you have made and therefore take up very little disk space. They can be shown or hidden at will and fine-tuned using layer masks and opacity settings, which makes them extremely flexible.

- A **Smart Object** is a special type of layer that, instead of pixels, contains embedded or linked raster or vector data. This makes it possible to apply filters non-destructively and alter the filter parameters in saved PSD and TIFF files. Smart Objects are extremely powerful, but some tools – such as the Clone Stamp and various Brush functions – don't support this technology.

Raw Development in Detail

Many raw image formats are proprietary and only work with cameras from the manufacturer that created them. Some are even unique to specific camera models. This makes it impossible for many image-processing programs to write adjustment data directly to raw files. In the course of the years, this deficit has led to the development of today's sophisticated non-destructive raw imaging workflows.

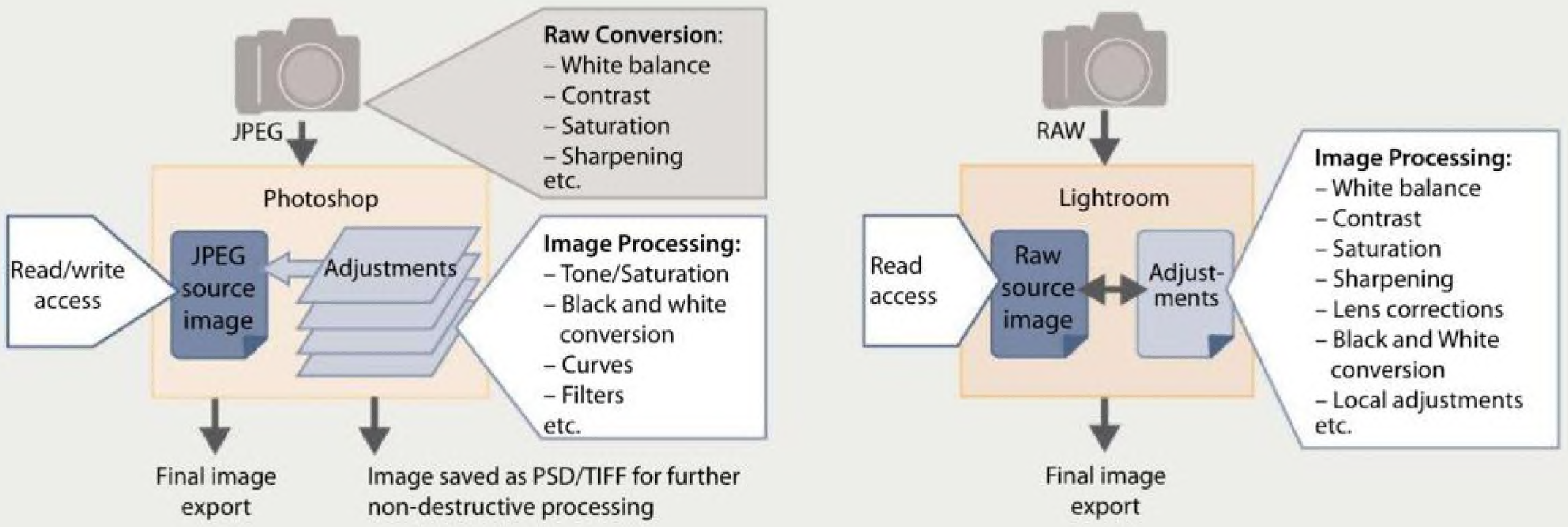
Analog darkroom processes serve as a useful analogy when describing how raw processing works, which is why the raw conversion process is often referred to as the 'digital darkroom'. Most of the tools involved

An image processed using two *Photoshop* adjustment layers. The upper 'Black & White' layer applies a sepia tone to the image, and neither this nor the Vibrance layer affects the pixels in the original image file.

Comparing Image-processing Workflows

A conventional Photoshop-based workflow saves image adjustments to the JPEG source file and alters the pixels that make up the image in the process.

You can usually only read from but not write to raw files. Adjustments (shown here in Lightroom) are saved either in the application's catalog or an additional XMP sidecar file that is saved alongside the image file.



use the original 'negative' (i.e., the raw image file) as the basis for the adjustments they apply, and the original negative remains unchanged no matter how many reproductions the photographer or lab technician produces.

Even if a raw image looks like a normal photo when you open it in a raw converter, what you are actually seeing is a very fine mosaic of red, green and blue pixels. The preview image displayed by the raw converter is like the image of a negative projected by an enlarger and represents just one of an infinite number of possible interpretations of the original image data.

Adjustments made using a raw converter are temporary, whether they affect the entire image or only selected details. They can be readjusted or undone at any time. The effects of your changes are displayed in real time, but you see a preview of what it would look like if you were to output it using the current settings rather than the image file itself.

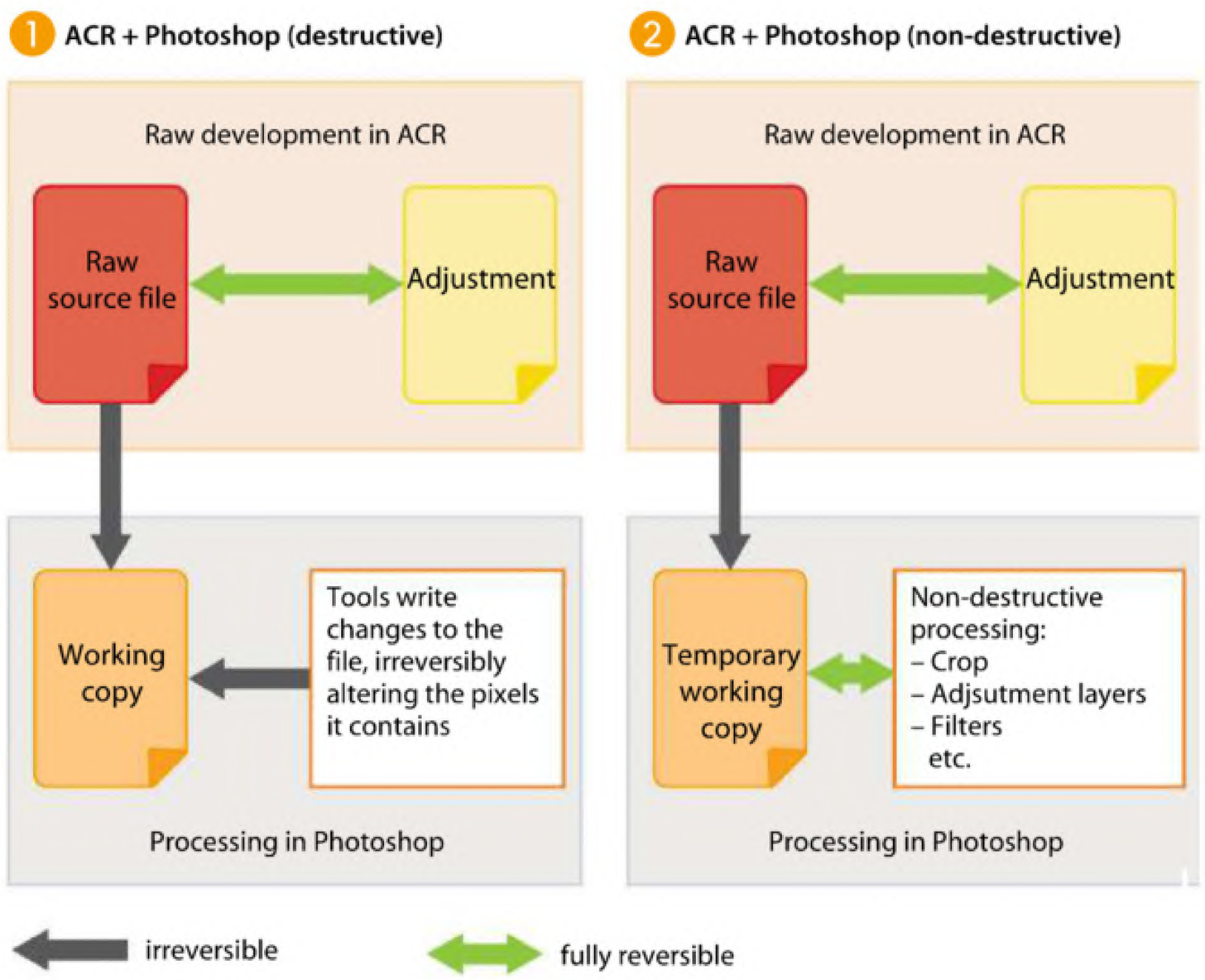
In a non-destructive workflow, your adjustments are saved as metadata in the form of an XMP 'sidecar' file, as part of the raw file or in the application's internal database. Many raw converters automatically save the last recorded state of an image and its corresponding preview. Whichever approach your software takes, the combination of the original file with the settings you have made exists only within the context of the application. If you open a processed raw image in a different converter, your adjustments will probably not be visible. However, *darktable* and some other programs can import and interpret various *Lightroom* settings.

If you want to use your processed image outside of the raw converter environment – for example, for printing, web publishing or fine-tuning in a different application – you have to convert it to a bitmap format such as JPEG or TIFF first in order to produce precisely defined pixels that other programs can correctly interpret. To continue our darkroom analogy, the outputted file is the equivalent of a print made from the original negative or slide.

An output file combines the original file with the settings you have made to create a new file. The original file and its corresponding metadata remain unchanged, so you can develop a new version of the original file at any time and create a new JPEG output file, just as many different prints can be made from a single analog negative.

Non-destructive Workflows in ACR, Photoshop and Lightroom

Photoshop supports various approaches to non-destructive processing, although an end-to-end, non-destructive workflow is not possible using Smart Objects alone. The following sections demonstrate how non-destructive technology works and details its advantages compared with other approaches to the workflow.



Every raw development process in *Photoshop* begins in the *Adobe Camera Raw* (*ACR*) module, which is tightly integrated with the main application but nevertheless remains an independent piece of software. Its functionality that is mostly identical to that found in *Lightroom*. Usually, *ACR* hands over the developed image to the main *Photoshop* application by way of a unidirectional export operation, and you cannot switch back and forth between the two programs. Smart Objects work around this limitation.

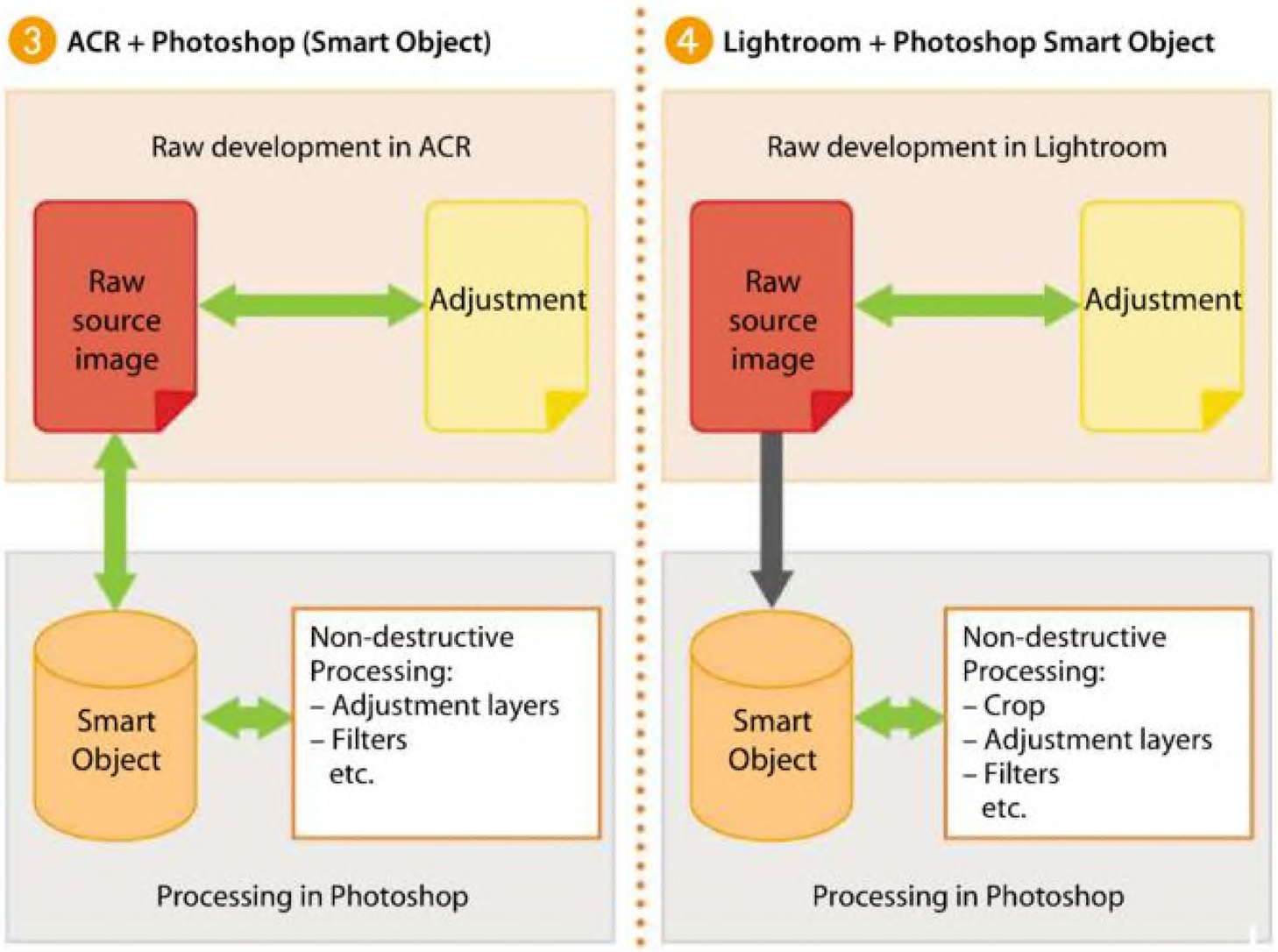
To open a developed image as a Smart Object in *Photoshop*, press the shift key to transform the *ACR* 'Open Image' button into the 'Open Object' button. Clicking it then automatically transforms the image into a Smart Object.

You can now apply filters, such as Adaptive Wide Angle, that aren't available in *ACR*. This particular filter can perform much more complex perspective and distortion corrections than *ACR*'s built-in Lens Corrections tool.

Because the changes you make to a Smart Object are non-destructive, you can revisit them and alter them as you wish. To adjust a Smart Object's settings, double-click the filter name located beneath the Smart Filter mask in the Layers panel. This re-opens the filter and allows you to readjust your settings.

You can return to your Smart Object's settings at any stage in the workflow simply by double-clicking its thumbnail in the Layers panel. However, because changes you make in *Photoshop* are assigned to the Smart Object's container and not its contents, you

This image was corrected using the *Photoshop* Adaptive Wide Angle filter, which can selectively correct converging lines and distortion



1 ***ACR*** **hands over the converted raw image to the main *Photoshop* application. Settings made in *ACR* are non-destructive, but 'normal' adjustments made in *Photoshop* are irreversible.**

2 **Adjustment layers and Smart Objects can be used to perform non-destructive adjustments in *Photoshop*.**

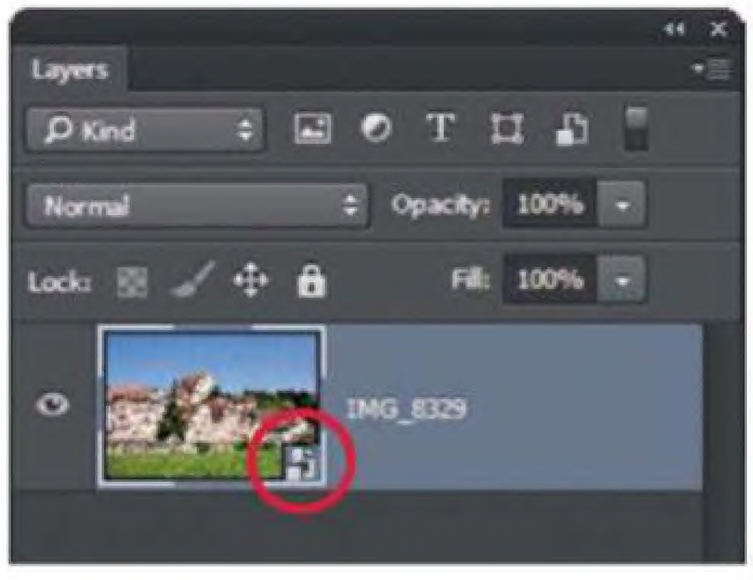
3 **Opening a raw image as a Smart Object provides you with an end-to-end non-destructive workflow. Any changes you make later to your raw development settings are automatically added to the *Photoshop* image.**

4 ***Lightroom*** **plus *Photoshop* is a less powerful team. You have to re-export your raw image if you want to include subsequent adjustments in your *Photoshop* image.**

won't be able to see them when your image is re-opened in *ACR*. When you are done with your new adjustments, click 'OK' to return to the *Photoshop* interface. To make these adjustments available when you re-open your image, you have to save it to *Photoshop*'s native PSD file format. When you have finished editing, you can save your image to JPEG for output. To open an image developed in *Lightroom* as a Smart Object, use the Photo > Edit In > Open as Smart Object In Photoshop command. Note that this command is a one-way street and you cannot re-open your new Smart Object in *Lightroom*. What you end up with is a copy of the file displayed in *ACR* with all the sliders reset to zero. Any changes you have made in *Lightroom* are already permanently applied.

The icon in the lower right-hand corner of the thumbnail indicates that a developed raw image has been opened as a Smart Object

The Adaptive Wide Angle filter enables you to precisely define straight, horizontal and vertical lines



Our Software Test Criteria

Raw development and image retouching are highly subjective processes, and the results you aim for depend a lot on your personal preferences. Similarly, all the raw converters we tested employ highly individual approaches to the same task. To keep the playing field level, we chose a set of basic capabilities that all of the applications we tested had to fulfil.

- Local adjustments are the basic prerequisite for detailed retouching work.
- The workflow has to be completely non-destructive. In other words, all adjustments are saved separately from the original image file and can be readjusted after an image is closed and re-opened.

Unfortunately, even some of the higher-quality raw converters (*RawTherapee*, for example) have no local adjustment functionality and are therefore not suitable for retouching work. If you want to perform detailed edits, you have to save your developed image to JPEG or TIFF and export it to a conventional image-processing program such as *Photoshop*.

This approach is anything but non-destructive. If you want to readjust your raw settings later, you have to either junk your edits and re-develop your raw image from scratch or attempt to edit your desired parameters in the exported file and, even if you export to the lossless 16-bit TIFF format, the conversion process always causes a loss of image data. Generally speaking, an exported image file gives you fewer color editing options than an original file that you process using a raw converter. This is especially true of JPEG files, which are quite lossy anyway.

Dropped Out in the First Round

Several popular raw converters didn't make the cut for our test due to a lack of usable retouching tools. For example, *DxO Optics Pro 9* has only a rudimentary dust removal brush and Nikon's relatively new *Capture NX-D* doesn't include the U-Point technology that made selective adjustments possible in its predecessor, *Capture NX 2*. The current version of *Digikam* has a slow, clunky workflow that separates the raw development and editing stages and is therefore of no real use for retouching work. However, the *Digikam* team is said to be working on a completely revised version of the software that enables non-destructive raw editing. *GTKRawGallery*, *Raw Photo Processor* and *RawTherapee* have no selective adjustment and image repair functionality at all.

Dodge and Burn

Brightening and darkening selected image areas is one of the fundamental capabilities we tested. These processes, which are as important now as they were in the days of analog darkrooms and, are are still often referred to using the analog terms 'dodging' and 'burning', are used to rescue lost shadow and highlight detail or add color to dull-looking skies.

We also tested color and contrast correction functionality and sharpening tools.

Removing Unwanted Details

The most popular options for giving reality a helping hand are 'clone' and 'heal' tools.

- Clone tools have been around since the very first version of *Photoshop* was released. In their simplest form, they copy a 'clean' image area and 'stamp' it into position to cover unwanted details such as dust particles, random objects or even people.
- Healing tools are generally of the 'smart' variety and are context-sensitive. This means that the color, texture and exposure in the source pixels are automatically adapted to suit the target area. Compared with clone tools, heal technology produces fewer implausible-looking borders between source and target areas.

Healing tools generally work best in low- or medium-contrast areas that don't contain too many edges, making a careful choice of source pixels essential. The more similar the source and target pixels are, the better your results will be.

Removing the tree and chimney is clearly a job for *Lightroom*

The tool replaces the selected detail with user-selectable source pixels. Color, brightness and other parameters are automatically adjusted to suit the target area.

ACDSee Pro

The Windows version of *ACDSee Pro* offers a huge range of management, development and editing features, while the *ACDSee Mac Pro* version has a less extensive toolset.

The program interface is made up of Manage, View, Develop and Edit tabs; the last two are where the retouching action takes place. The separation of development and editing into two tabs is an indication of how the program treats raw files: all adjustments are destructive apart from those made in the Develop tab. The raw converter module produces very good results.

The Edit tab contains a broad range of tools for cropping, rotating and split toning your images, as well as black-and-white conversion, lens error correction and heal and clone functions. Unfortunately, all the adjustments you make in Edit mode are applied destructively (i.e., permanently). If you attempt to switch back to Develop mode, you are given the choice of saving all your develop and edit settings to a new JPEG or TIFF file or discarding them all and starting again.

Poor Masking Tools

Some local adjustments can be made non-destructively using the Develop Brush tool, which has user-adjustable Nib Width and Feathering settings and an option that shows your brush strokes as you make them. You can define up to seven separate brushes per photo or session and switch between them by selecting the appropriate checkboxes in the Develop Brush tool panel.

The lack of automatic masking functionality and vector-based selection tools makes complex selections extremely fiddly in *ACDSee*, even if you use a graphics tablet and pen. Applying the brush with the right-hand mouse button pressed turns it into an eraser. The settings you can adjust using the Develop Brush are called Exposure, Saturation, Fill Light, Contrast and Clarity, but these aren't sufficient to perform genuine recoloring. The linear and radial gradient tools offer only the same simple options as the Develop Brush.

Clunky Retouching

The Heal and Clone tools have adjustable Nib Width and Feathering settings. A source area is selected by right-clicking the appropriate place in the preview image, which wouldn't be a bad thing if it were possible to adjust the source and target areas later on. However, this is not the case, and if you get either (or both) selections wrong, you have to discard both and start afresh. This makes complex retouching tasks an extremely hit-and-miss affair.

Additionally, the Repair tool tends to produce rather smudgy results when used to correct skin blemishes in portraits, and is is not possible to apply multiple instances the way you can with the Develop Brush. This means that even if just one of a sequence of adjustments doesn't turn out right, you have to discard them all and start again.

***ACDSee Pro* offers a maximum of seven separate raw adjustments, which should be sufficient in most cases. Click the checkboxes at the bottom of the Develop Brush tool panel to switch between adjustments.**

Individual Software Tests

After the initial elimination round, we were left with a promising selection of test candidates that included Adobe Lightroom, Capture One Pro, ACDSee Pro, Corel AfterShot Pro, LightZone and darktable. The following sections take a detailed look at the retouching functionality they offer.

Adobe Photoshop Lightroom

Adobe Photoshop Lightroom, or *Lightroom* as it is usually known, is one of the most popular commercial raw converters around. Most photographers who shoot raw have at some point tried this or its *Photoshop* counterpart, *Adobe Camera Raw* (usually known as *ACR*).

Instead of actually processing raw or JPEG images, *Lightroom* creates a set of instructions that define how to treat a copy of the original file when you export it. These are saved either in the application's own catalog (i.e., its internal database) or in a separate XMP-format 'sidecar' file. The original raw file remains unchanged.

Lightroom is undeniably one of the most powerful raw converters available today. Its features include HSL (Hue, Saturation and Lightness) corrections for eight separate color channels, the Tone Curve tool, customizable camera profiles, automatic and manual lens corrections, and comprehensive black-and-white conversion tools.

Most conventional editing steps can be performed within the *Lightroom* environment, which also offers clone and heal tools, automatic red-eye removal and selective local adjustment tools.

However, unlike *Capture One Pro*, *Lightroom* doesn't support layer functionality, which makes retouching work quite complex. And it doesn't have any vector-based selection tools (circles, polygons etc.). Masks are created using the brush tool, although the 'Auto Mask' option makes it relatively simple to create complex masks using just a few brush strokes (provided that the areas covered are of the same or similar colors).

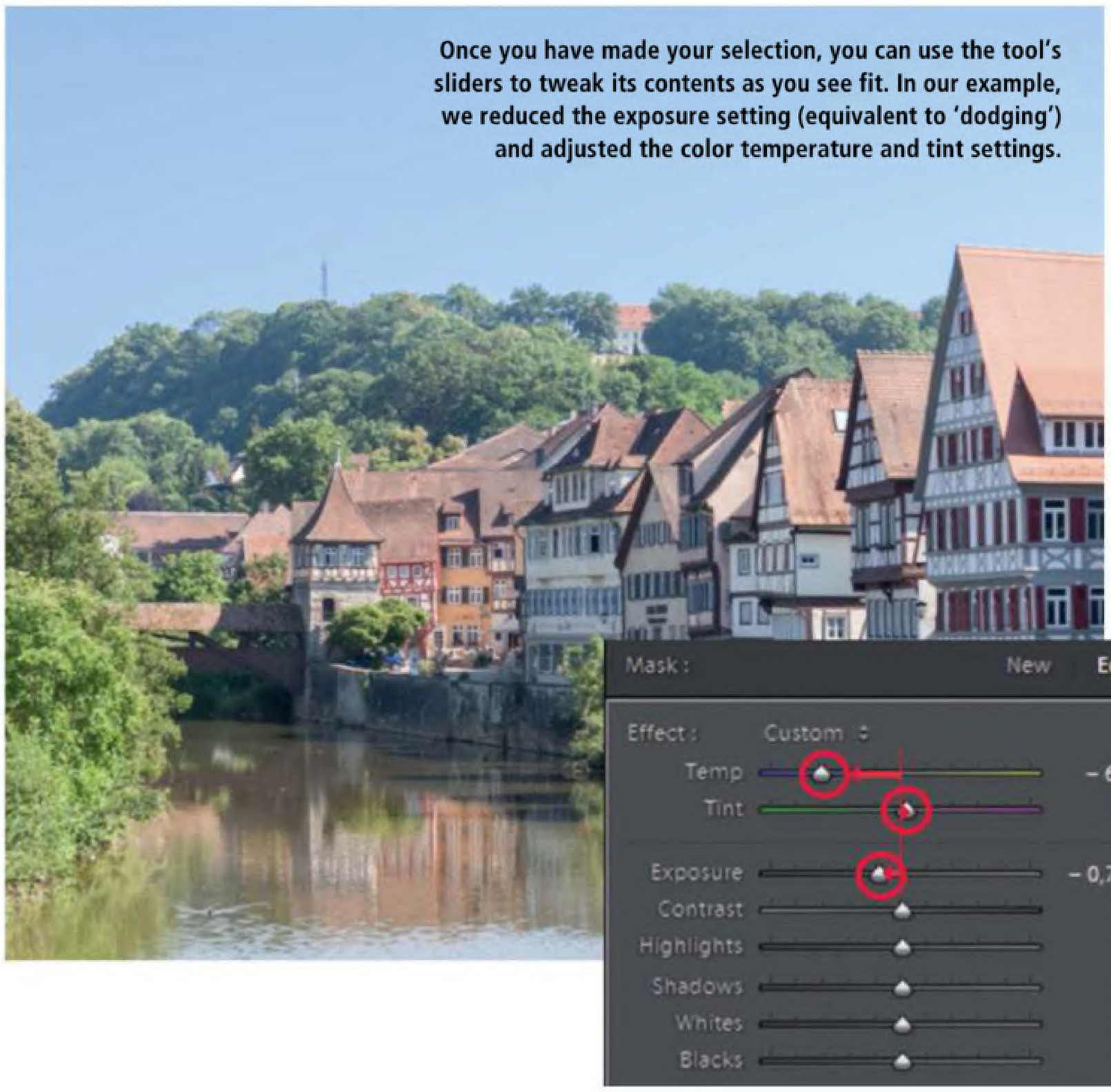
Local Adjustments

The Adjustment Brush, with its Size, Feather, Flow and Density (i.e., opacity) settings, is the tool of choice for applying local adjustments to selected (i.e., masked) areas.

You can apply adjustments to multiple areas in a single image, and each adjustment is marked with a pin. Clicking a pin activates the corresponding mask and enables you to change its shape and adjust its settings. The principle is easy to learn and, with a little practice, is quick and easy to apply.

The lateral light in this shot makes the clear blue sky look pale and washed out – a typical digital repair job is needed

The 'Auto Mask' option in the Adjustment Brush tool makes it easy to select single-colored objects with complex outlines



Once you have made your selection, you can use the tool's sliders to tweak its contents as you see fit. In our example, we reduced the exposure setting (equivalent to 'dodging') and adjusted the color temperature and tint settings.

The task here is to desaturate the shadows in the bottom left-hand corner

We used a linear graduated filter to desaturate the colors and keep the results looking natural

You can adjust individual areas asymmetrically too. The Graduated Filter tool works just like the analog tool of the same name, placing a two-tone mask over the image with an adjustable transition between the different colored zones. Graduated filters are popular in landscape photography, where they are often used to balance brightness between the sky and the rest of a scene.

Many raw converters have graduated filter tools, and the *Lightroom* version offers linear and radial filter types that you can place anywhere within the frame and drag to cover the desired area. Once you have positioned a gradient, you can adjust its parameters the same way as you can for the Adjustment Brush.

Healing Functions

Lightroom includes clone and heal functions that are applied using a brush. The 'Heal' option in the Adjustment Brush tool isn't suitable for repairing large objects or target areas that differ in size and shape from the source area, as these quickly produce obvious fringing effects at the edges of the processed area. It is better to use the 'Clone' option in such situations, even if you have to clone several areas to completely repair the object in question.

You can adjust clone and heal actions by dragging a pin to a new position. However, there is no way to create an overview that simultaneously shows all of your source areas – you can only view the outline of the mask whose pin you have just clicked.

The biggest drawback of the *Lightroom* Clone and Heal functions is that you can't alter the masked area. You have to draw your mask in one go and it is 'set in stone' the moment you release the mouse button. If the result doesn't suit your requirements, you have to delete the corresponding pin and start over, so complex retouching tasks become quite laborious.

Due to a layer of reflective cells that human eyes don't have, dogs' eyes reflect either blue or green light when illuminated using flash. The 'Pet Eye' option included in the *Lightroom* Red Eye Correction tool makes it simple to correct the effect.

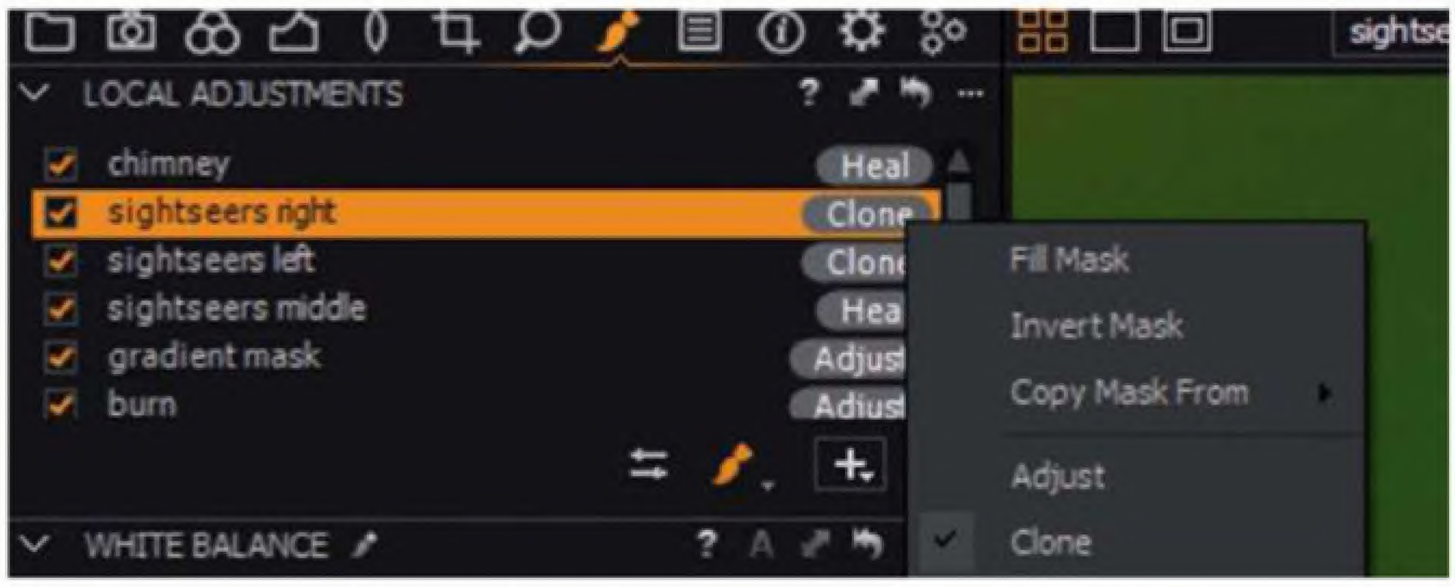
Capture One Pro

Phase One's *Capture One Pro* enjoys an excellent reputation among pro portrait and product photographers, and the $299 price tag for a single license is pro-grade too. The alternative subscription model costs $10 per month and the pared-down Express version, which lacks local adjustment functionality, costs $99. This article concentrates on the Pro version.

Capture One's fans love its high-quality raw conversions, great performance (thanks to multi-GPU support), excellent shadow and highlight recovery tools, HDR effects and pro-grade camera and lens profiles. It also offers tethered shooting functionality which you can use to control a connected camera from within the program interface. Adjustments made in *Capture One* are stored in a separate metadata file that is assigned to the unchanged raw original.

The *Capture One* interface is organized in tabs like *Lightroom*, and you can add custom tabs that contain tools you use regularly. Once you have set up the interface to your liking, you can save the entire workspace as a preset.

The size, hardness and opacity of the mask are easy to adjust using the sliders in the Brush Settings context menu (right click to access)



If you are not sure which tool is better for a task, you can use the context menu to convert clone layers to heal layers and vice versa

Layers Provide a Clear View

Non-destructive selective adjustments are made using layers and masks that are applied using a brush or a gradient mask. You can rejig these adjustments at any stage in the workflow. Compared with *Lightroom*, the layer-based approach taken by *Capture One* makes it much easier to keep track of your individual adjustments. You can add or erase brush strokes to fine-tune the mask, and each layer can be inverted, duplicated, shown or hidden as necessary. Hiding a layer deactivates the corresponding adjustment.

You can apply all the available tools to an active layer, which in practice means you can apply just about any conventional adjustment using just a couple of brush strokes. If you need to tweak your global adjustments, simply activate the background layer. Capture One's gradient masks are always linear but, as in *Lightroom*, you can adjust their shape using the brush.

It took six separate *Lightroom* clone actions to plausibly remove the left-hand car from this scene. Each clone mask is indicated by a pin, and the source and target areas for the active pin are displayed. Unfortunately, this is all that *Lightroom* has to offer in the way of user-controlled options.

In this example, we used a gradient mask to emulate an analog graduated filter. The original image was exposed for the foreground, and the sky and ocean could do with brightening. The gradient mask ensured that our adjustment was only applied to the upper portion of the frame. The light-colored rocks in the background were erased from the mask to exclude them from its effect.

Reliable Tools

Version 8 of *Capture One Pro* saw the addition of layer-based Clone and Heal tools. Both are highly effective – provided, of course, that you select appropriate source pixels for them to work with.

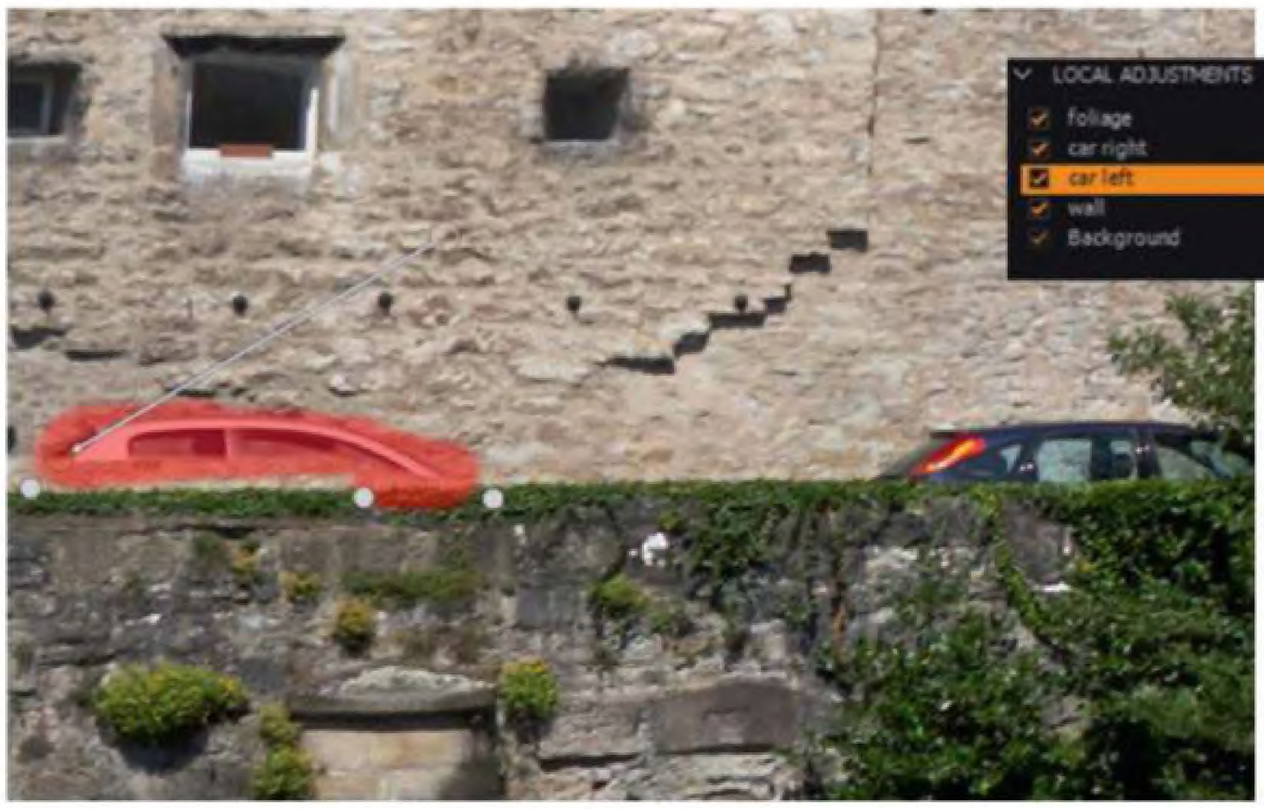
To make a repair, create a new layer and use the brush to define the area you wish to alter. As soon as you release the mouse button, the software automatically searches for suitable replacement pixels. If you need to alter the location of the source area (and you often will), simply drag it to a more appropriate place. The boundaries of the source area are indicated by a translucent red mask that is sometimes quite difficult to see. *Lightroom*'s approach of displaying both the source and target areas for the active pin makes it easier to make precise adjustments. In *Capture One*, clone and heal masks can be extended or erased at any time using the brush.

We found that setting a Hardness value of around 50 produced the best Heal results but much lower values worked better on Clone layers.

You can switch layers between the two modes to check which type of adjustment works best.

Pro-grade Functionality

Because it is squarely aimed at the pro sector, *Capture One* doesn't have a dedicated red-eye correction tool. If you do end up requiring this kind of effect, using a local adjustment layer to darken or desaturate your subject's pupil produces the same effect.



Applying multiple clone or heal layers is much easier in *Capture One*. Each layer has its own entry in the tool panel and hiding a layer switches off its effect, which makes it easy to check whether the layer has the desired effect. The active mask is displayed in translucent red.

LightZone

LightZone is one of the two freeware products we tested. It used to be a commercial venture but its owner, Fabio Riccardi, gave up the business in 2011 and published the source code, which was immediately adopted by a legion of independent developers who continue to update what is now called the 'LightZone Project'.

LightZone is available free for Windows, Mac OS X and Linux. We tested it on Windows 7 and OS X Yosemite, and both versions proved stable and reliable. It can read most popular raw formats and can also open JPEG and TIFF files. Internally, *LightZone* uses the LZN file format and the .jpg filename extension. Each file consists of a JPEG variant of the original image and an adjustment stack. The workflow is completely non-destructive.

Zones like Ansel Adams

What makes LightZone unique is its ZoneMapper feature, which is based on the zone system of exposure made famous by Ansel Adams. The original system, based on 11 grayscale zones (0, I , II, III etc. up to X), was designed to help the photographer produce precisely and evenly exposed black-and-white images. Zone 0 represents pure black, while zone V represents neutral gray and zone X pure white. The intervals between each zone represent one f-stop.

Even though some photographers still use the system to calculate their exposures, digital photo technology has continually pushed it toward obscurity and its heyday in the days of analog monochrome photography is well and truly over.

For photographers who are more familiar with other contemporary raw converters, *LightZone*'s basis in analog techniques makes it less intuitive to use. Instead of a tone curve tool or contrast slider, it has the unique ZoneMapper tool, which divides each image into 16 separate brightness zones. The ZoneMapper Preview displays the locations of each zone within the frame as required.

With a little practice, the ZoneMapper provides a quick and easy way to make selective adjustments to your images. To brighten or darken the tones in a zone, simply drag its lower edge upward or downward. Clicking the yellow 'x' icon next to a selected zone deletes the adjustment associated with it. You can use multiple ZoneMappers on a single image – for example, to adjust brightness and contrast separately.

LightZone stacks all the tools and adjustments you apply, which can be deactivated, undone, readjusted and reordered as required (i.e., completely non-destructively). It also supplies a wide range of non-destructive ready-made styles.

Vector-based Masks

Newly selected tools are initially applied to the entire frame, and you have to define a vector-based region if you want to apply them selectively. The program offers Polygon, Spline and Bezier region tools and you can adjust a selection by altering its shape and changing the feather setting. The adjustment is applied to the region within the inner feather border and can be further tweaked by moving its control points. Unfortunately, there is no adjustment brush available for tweaking fine details.

Once you have got used to the *LightZone* system, you will find it a fast and precise way to apply raw retouching steps. Remember that a newly defined region is always applied using the uppermost tool in the stack.

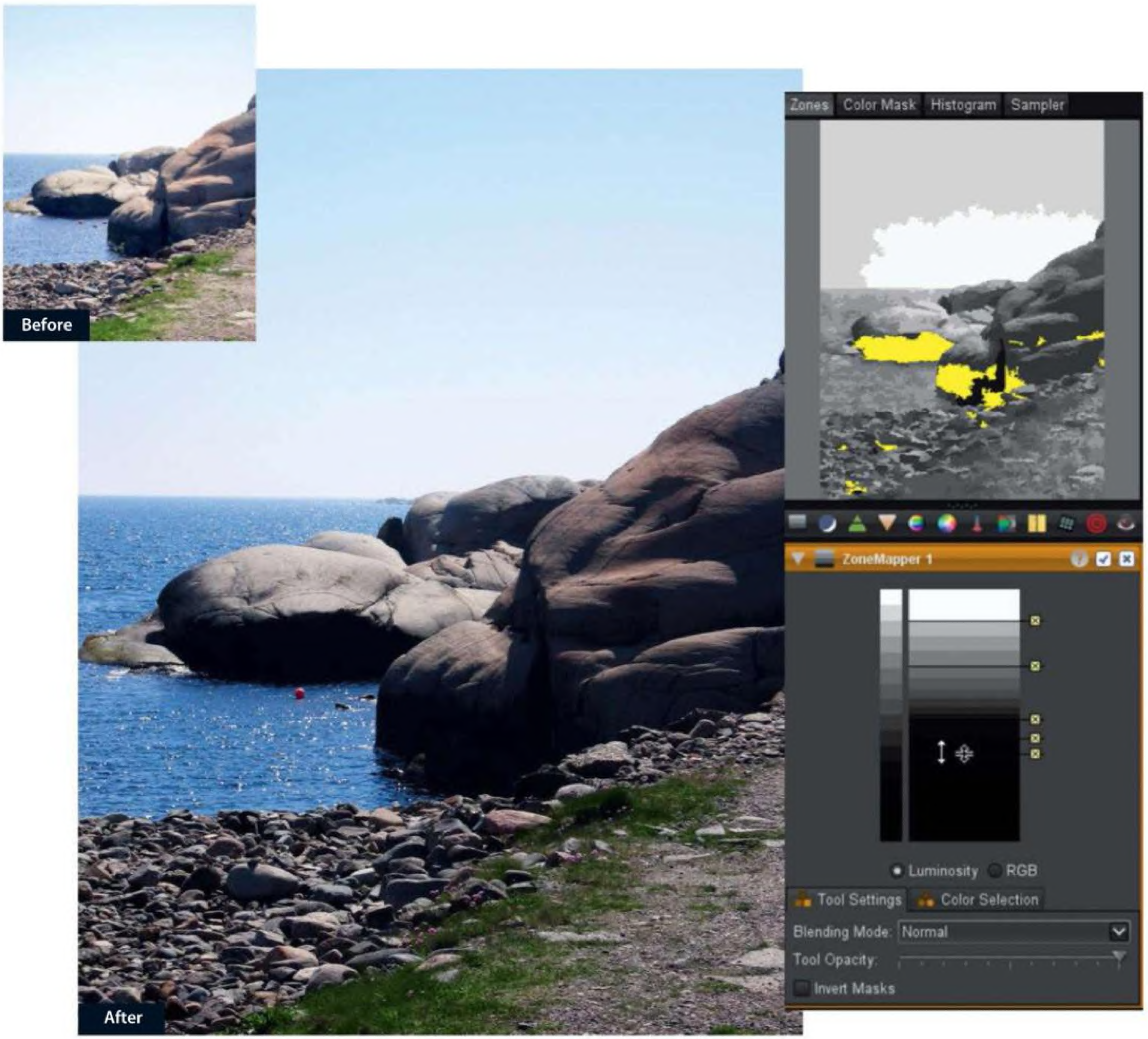
As well as the user-controlled selective tools, *LightZone* also has automatic clone, spot removal and red eye removal tools. There is no heal function.

The Spot and Clone tools stem from *LightZone*'s early days and haven't been updated recently. Both are located in the

***Lightzone*'s Red Eyes tool is intuitive to use, and you can adjust its diameter, roundness and feathering settings by double-clicking your selected region and dragging the control points that appear. As with all the other tools, each new Red Eyes adjustment is added to the stack.**

toolbar beneath the ZoneMapper preview window and are automatically added to the top of the stack when you activate them. Once you have defined a region, you can alter the feather setting using your mouse, as before.

The Clone tool's source region is indicated by a crosshairs icon on the cursor and can be dragged to a new location as required. Its only real drawback is that while you can see the center you cannot see the borders of the source region. This makes fine-tuning tricky, and the crosshairs are sometimes difficult to locate in highly textured areas. The Spot tool is designed for eliminating dust, skin blemishes and other minor artifacts and, like the Clone tool, copies a source region with a feathered edge to the target region you select. You can adjust the size of the corrected region but the tool selects the source region automatically, and sometimes makes strange choices.



By emulating the the famous zone system of exposure modulation, the *LightZone* ZoneMapper enables you to selectively brighten or darken individual image areas

darktable

darktable is the second free, open source program we tested but, unlike *LightZone*, it is only available for Linux and Mac OS X. Our attempts to compile it for Windows drew a blank. We tested the Mac version and found its interface to be very similar to the one used in *Lightroom*, with a 'lighttable' tab for viewing, sorting and rating your images and a 'darkroom' tab for processing. It is also capable of importing some of the settings made in images developed using *Lightroom*.

A 'tethering' tab provides for tethered shooting and a 'map' tab displays the locations of geotagged images on OpenStreetMap, Google Maps and Maps-For-Free.

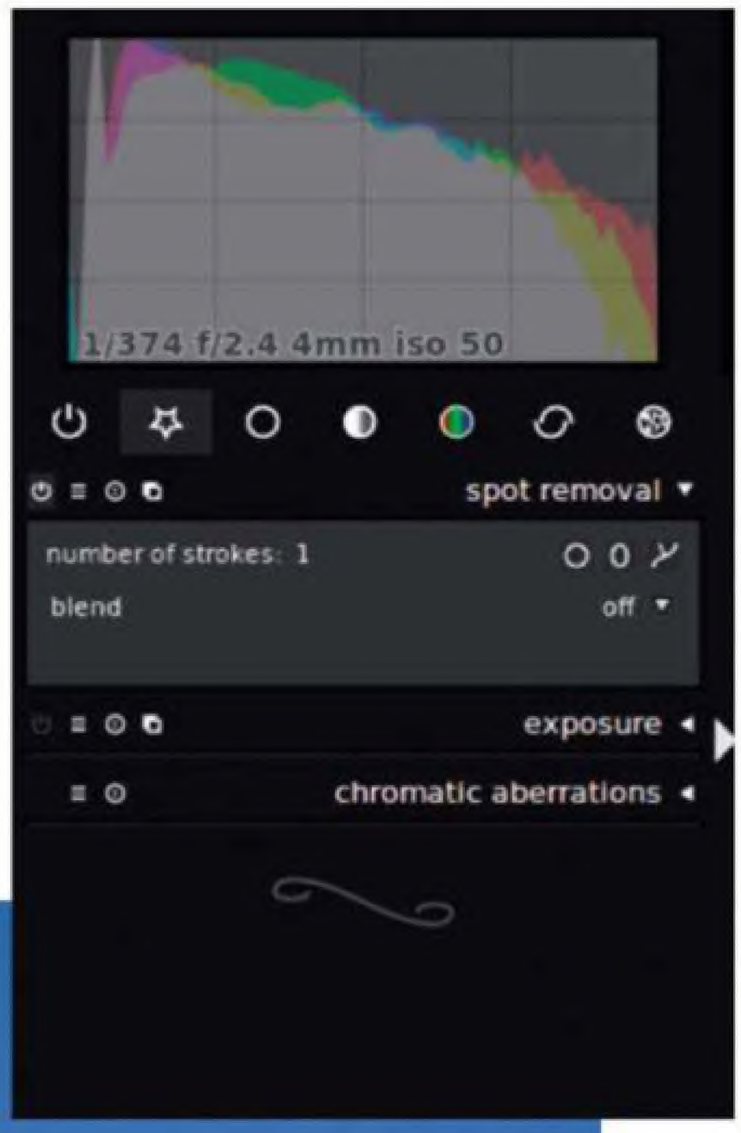
The 'lighttable' tab has a wide range of functions and, as well as adding star ratings, color tags and keywords, enables you to group images that contain similar colors or that are similarly exposed. These are great tools, but they are not particularly intuitive to use.

As in most other raw converters, the 'darkroom' tab consists of separate tools and functions (called 'modules' in *darktable*) that you invoke as required. The choice of modules is enormous and, alongside familiar adjustments such as exposure, saturation and shadow/highlight adjustments, includes three separate denoising tools.

The huge range of options and cryptic naming conventions are a little confusing for new users, but it is actually quite an easy program to use once you get used to it. You can also use the 'Favorites' module group to gather the modules you use most often in one place. *darktable* is fast and provides true non-destructive editing functionality. It can process a wide range of popular raw formats as well as JPEG, TIFF and PNG images. Adjustments are saved in XMP sidecar files.

Module-based Masks

When local adjustment functionality was finally introduced to *darktable* in 2013, it was definitely worth the wait. Unlike in the other programs discussed in this article, *darktable* masks are available directly in each module.



The clone tool (called 'spot removal' in *darktable*) offers circle, ellipse and path-based selections. There is no brush tool, so you have to create a closed shape to make a selection.

If you are already using a module globally, use the 'duplicate instance' command in the tool's menu and turn the 'blend' option on using the switch in the bottom right-hand corner of the tool panel. The default 'off' setting means that the settings you make are applied to the entire frame.

Selecting the 'drawn mask' option in the blend menu reveals brush, circle, ellipse, path and gradient drawing tools, which you can use to draw a mask that limits the area the tool's effect is applied to.

If you use the brush, releasing the mouse button reveals the corresponding path. During our test, drawing complex paths with multiple twists and intersections slowed the program down significantly and we even managed to crash our test Mac at one point. Once you have drawn a mask, you can use the blend menu to assign it to other modules to and refine your adjustments. The masks you apply are then effectively stacked.

Masks also feature blend modes – a feature you have probably already used in *Photoshop*. These determine how your adjustments are applied to an image, giving you even more fine-tuning options for your retouching activities.

You can adjust radius, opacity and feathering for circular and elliptical masks, and in path-based masks you can also shift the control points and alter their softness. If you assign multiple masks to a module they are automatically grouped. In the 'mask manager' panel, you can apply Boolean operators to combine and move shapes within a group.

Another high-end feature is parametric masks, which enable you to apply adjustments to areas of selected brightness, saturation and color. Experienced users can use this feature to create luminosity masks for darkening individual highlight details or saturation masks for pepping up selected colors without oversaturating other areas.

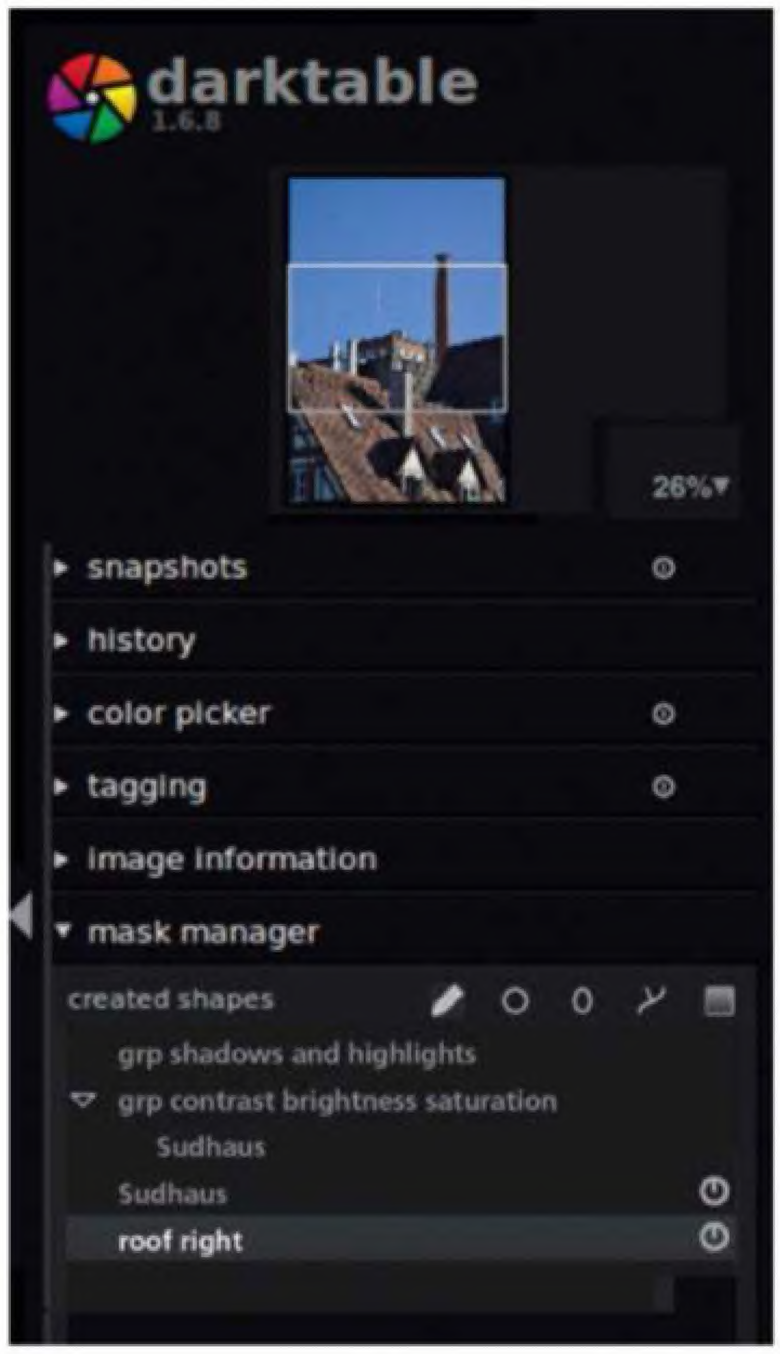
Overall, *darktable* offers a much more powerful toolset than *Lightroom* and provides experienced users with extremely comprehensive retouching options. It's a shame that the masking tools aren't a little easier to use!

Cloning

darktable's clone tool, called 'spot removal', offers circle, ellipse and path masking tools. Without a brush, however, it is not as useful as similar, brush-based tools in other programs.

To remove a spot or other blemish, mask the appropriate area. *darktable* then automatically suggests a source area that you drag into position using your mouse. Spot removal can be combined with parametric masks, allowing you to make very finely nuanced adjustments.

There is no dedicated red eye removal tool yet, but you can achieve the same effect by masking affected areas and desaturating or darkening them.



The 'mask manager' is a powerful tool that makes it simple to keep track of all your masking activities

***darktable*'s path-based masking tools are great for selecting clearly defined architectural details but quite fiddly to use when selecting complex outlines**

Corel AfterShot Pro

Until quite recently, Corel's *AfterShot Pro* (the successor to *Bibble*) was considered a classic piece of abandonware. Corel acquired Bibble Labs in 2011 and released *AfterShot* the following year. The Bibble community was disappointed by Corel's apparent lack of enthusiasm for updating the program, and many of the plug-ins and features no longer worked as before. Finally, in May 2014, Corel introduced the 64-bit *AfterShot Pro 2* with an expanded lens corrections database and a raft of interesting functions and well implemented tools. The raw workflow in the new version is completely non-destructive and, like *Lightroom*, uses XMP sidecar files to store adjustment settings.

Layers Support

The Layers panel, which is accessed via a button in the top right-hand corner of the main window, is the gateway to the retouching tools. You can use Ellipse, Polygon and Curve tools to create adjustment regions, and use the Brush to draw freehand regions and fine-tune regions drawn using the other tools. The Curve tool isn't entirely intuitive to use and takes some getting used to. If you adjust a region's settings in the active layer, your changes only apply to the selected region. Layers can be stacked and their order changed, which makes it relatively simple to perform complex retouching tasks.

Fiddly Healing

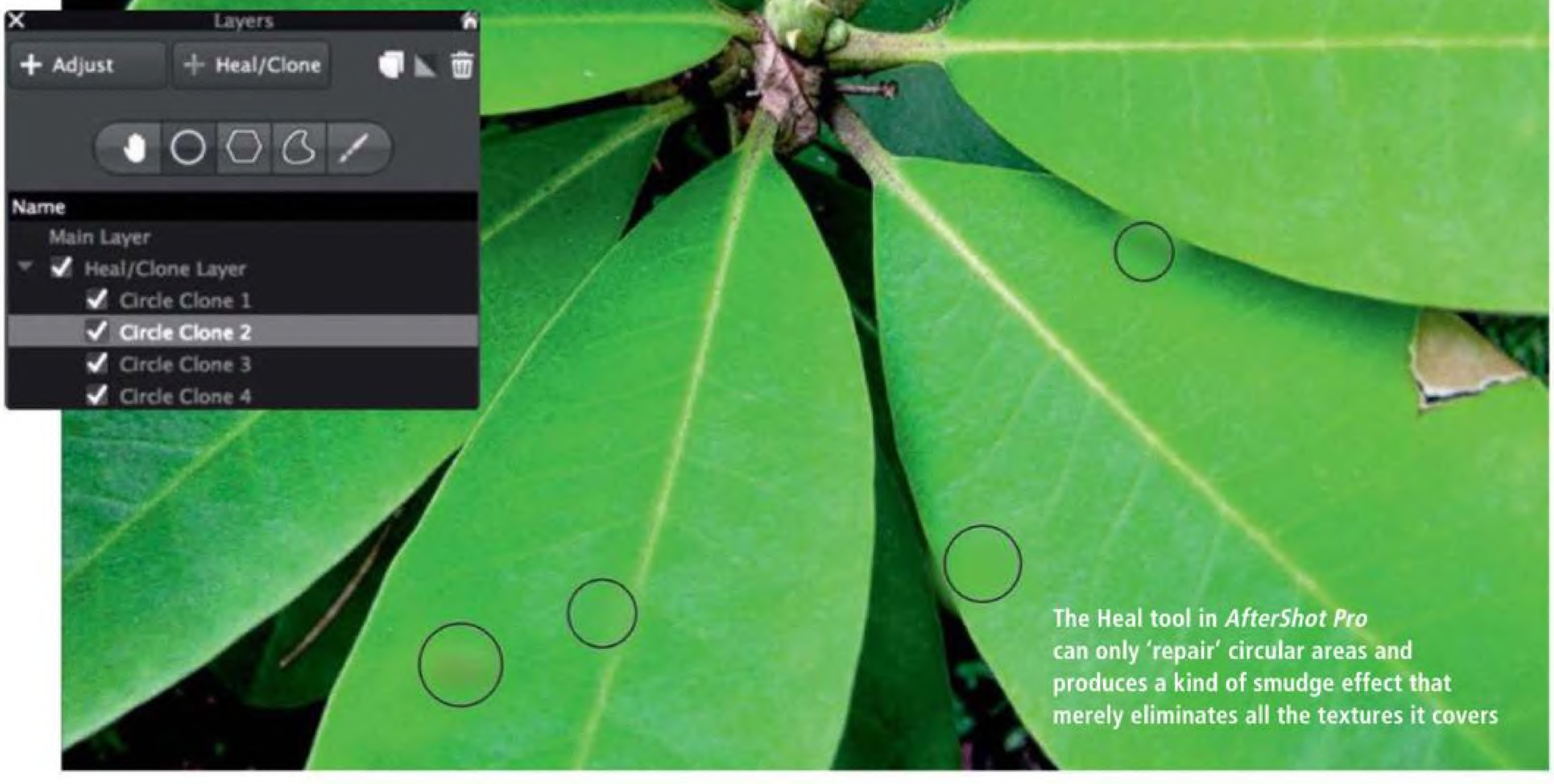
AfterShot Pro has non-destructive Heal/Clone and red eye removal tools.

The Clone tool is layer based and is very effective. To apply it, create a new Heal/Clone layer and mask the area you wish to adjust. You can choose between Circle, Polygon and Curve shapes for your mask, but you cannot use the Brush to draw freehand Heal/Clone shapes.

The Heal tool is less flexible and can only be applied using a circular mask. It is really only suitable for minor repairs to skin blemishes, hot pixels, dust particles and other unobtrusive artifacts, because it produces a kind of generic smear effect that simply covers up the target details, rather than creating textures that match the target region. You have to create a new mask for each detail you want to repair, and the size of the circular mask cannot be adjusted by dragging it, as we would have liked, but has to be fine-tuned separately using the Size slider, either before or after you create your Heal layer.

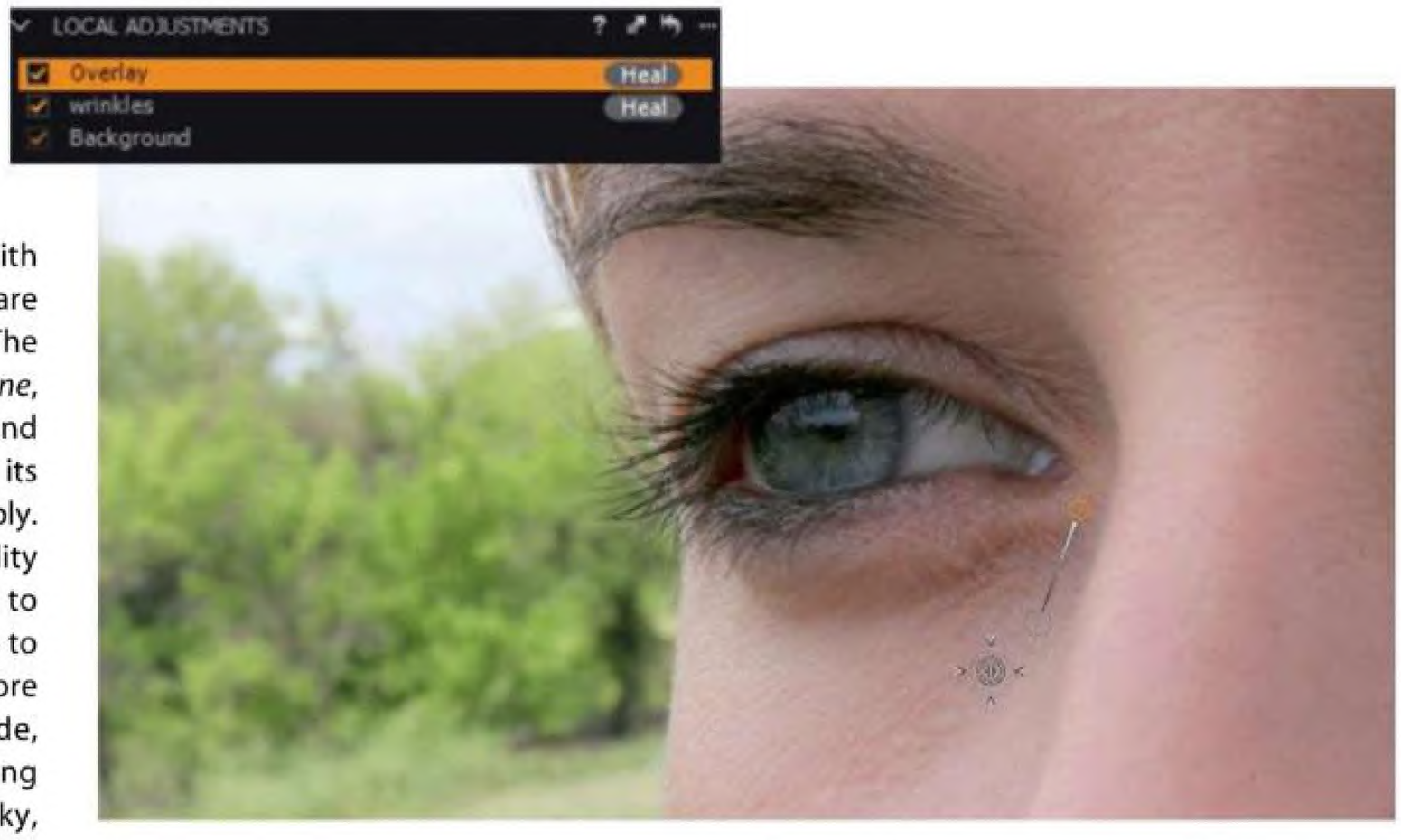
All in all, retouching in *AfterShot Pro* is a fiddly business based on tools that appear to be poorly developed or simply unfinished.

All local adjustments and retouching tasks performed in *AfterShot Pro* are controlled via its simple Layers panel



The Heal tool in *AfterShot Pro* can only 'repair' circular areas and produces a kind of smudge effect that merely eliminates all the textures it covers

Conclusions



***Capture One*'s Local Adjustment layers are ideal for quickly removing creases, skin blemishes and other unwanted artifacts in portraits**

Not all programs designed with non-destructive processing in mind are suitable for advanced retouching work. The clear winner in this issue's test *Capture One*, with its high-quality raw conversions and highly fine-tunable adjustments. Overall, its tools are extremely flexible and easy to apply.

The non-destructive layers functionality in Corel's *AfterShot Pro* is also very easy to use, even if its raw conversions aren't up to the standard of those produced by the more expensive *Capture One*. On the plus side, *AffterShot Pro* offers vector-based masking tools, but it loses out with its clunky, brushless clone tool and virtually unusable heal tool.

Adobe *Lightroom 6/CC* delivers results of similar quality to those from *Capture One* and offers a similarly comprehensive toolset, although its lack of adjustment layers makes it much more difficult to keep track of your edits. The lack of functionality for changing the shape of the adjustment brush mask is a major drawback, although graduated filter masks can be tweaked using the brush in the normal way.

If you are on a limited budget but still want to have a go at non-destructive raw retouching, give *LightZone* a try. Its intuitive and highly visual user interaction will make up for the steep learning curve as you get used to its unuusal interface. Raw conversion quality and the choice of retouching tools are both very good.

darktable is another excellent free alternative but is only available for Mac and Linux. It offers a wide range of interesting features that are quick to use once you have familiarized yourself with its quirky modus operandi. On the upside, stackable modules, blend modes and parametric masks provide highly fine-tunable retouching options, but the clunky brush tool spoils overall user experience.

ACDSee Pro was the most disappointing of the commercial programs we tested. Complex shapes are extremely difficult to mask effectively and its retouching tools are sparsely featured. The heal and clone tools are difficult to apply effectively and individual steps cannot be undone without trashing the entire session. All in all, it is impractical and not really suited for use as part of a productive workflow. (sts)

Raw Converters with Retouching Functionality

Program	ACDSee Pro 8	AfterShot Pro 2	Capture One Pro 8.2	darktable 1.6.7	Lightroom 6	LightZone 4.1.1
Manufacturer	ACD Systems	Corel	Phase One	darktable team	Adobe	LightZone Project
URL	acdsee.com	corel.com	phaseone.com	darktable.org	adobe.com	lightzoneproject.org
Operating systems (Win/Mac/Linux)	✓/✓/–	✓/✓/✓	✓/✓/–	–/✓/✓	✓/✓/–	✓/✓/✓
Single license price	$99.99	$80	$299	free	$149	free
Trial version	15 days	30 days	60 days	none	30 days	none
Selective Adjustments						
Adjustment layers	✓ (max. 7)	✓	✓	✓ (applied per module)	–	✓ (applied per module)
Adjustment brush	✓	✓	✓	✓	✓	–
Path-based selections	–	✓	–	✓	–	✓
Linear gradients	✓	–	✓	✓	✓	–
Radial gradients	✓	–	–	–	✓	–
Clone/Heal Tools						
Clone brush	✓	–	✓	–	✓	–
Path-based cloning	–	✓	–	✓	–	✓
Healing brush	✓	–	✓	–	✓	–
Path-based healing	–	✓ (circle only	–	–	–	✓ (circle only)
Red eye removal	✓	✓	–	–	✓	✓
Other Features						
Import formats (Raw/TIFF/JPEG/PSD)	✓/✓/✓/✓	✓/✓/✓/–	✓/✓/✓/–	✓/✓/✓/–	✓/✓/✓/✓	✓/✓/✓/–
Export formats (JPEG/TIFF/PSD/DNG)	✓/✓/✓/–	✓/✓/–/–	✓/✓/✓/✓	✓/✓/–/–	✓/✓/✓/✓	✓/✓/–/–
Raw settings saved to (Sidecar file/Catalog)	XMP/–	XMP/–	–/✓	XMP/–	XMP/✓	LZN/–

✓ included – not included

How To Create a 'Color Key' Effect with Capture One Pro

Thanks to its Local Adjustments and Layers functionality, Capture One Pro 8 can be used to perform a wide range of raw retouching tasks. The following example demonstrates how to use it to create a 'color key' effect that leaves only selected details in color in an otherwise black-and-white image.

The following steps explain how to preserve the colors in this cat's eyes and nose while converting the other tones to black and white. The retouched image is much more intense than the original.

1 Add a new layer

Switch to the Local Adjustments tool tab.

Click the '+' button in the lower right-hand corner of the Local Adjustments tool panel to create a new layer. Give the new layer a meaningful name – in our case ColorKey – and press the return key.

***Capture One*'s powerful layers functionality is the basis for all retouching tasks**

2 Draw a mask

Click on the new layer to activate it. The active layer is highlighted in orange.

Long press the brush icon in the Cursor Tools toolbar at top center in the program window and select the 'Always Display Mask' option in the drop-down menu that appears. The plus sign on the cursor indicates the center of the brush that you can now use to draw your mask – the area covered by the mask is shown in translucent red in the preview window.

Make appropriate settings via the context menu and use the brush to fill in the areas you want to adjust. If your mask is too large, select the 'Erase Mask' option in the drop-down menu and use the brush with the mouse button pressed to erase any excess areas. Use the keyboard shortcuts 'B' and 'E' ('Brush' and 'Eraser') to switch between the two modes.

Masked areas are highlighted translucent red

Dodging and Burning

Once you have created masks for the areas you wish to brighten or darken using the steps described on the previous page, you can fine-tune your settings using the sliders in the Exposure tool panel.

3 **Invert and fine-tune the mask**
Right-click the active mask entry in the Local Adjustments tool and select the 'Invert Mask' option. This unmasks the previously masked area and masks the rest of the frame.

Once you have drawn your mask, select the 'Only Display Mask While Drawing' option in the Brush tool menu. Now, instead of the usual permanent red mask, only your adjustments will be visible.

Shift the Saturation slider to the left to desaturate the colors in the masked areas and fine-tune the settings for the other Exposure sliders as necessary.

If you select the 'Never Display Mask' option in the Brush menu, any adjustments you make using the brush will be displayed in real time in the preview window the moment you release the mouse button.

The inverted mask

Auto Mask

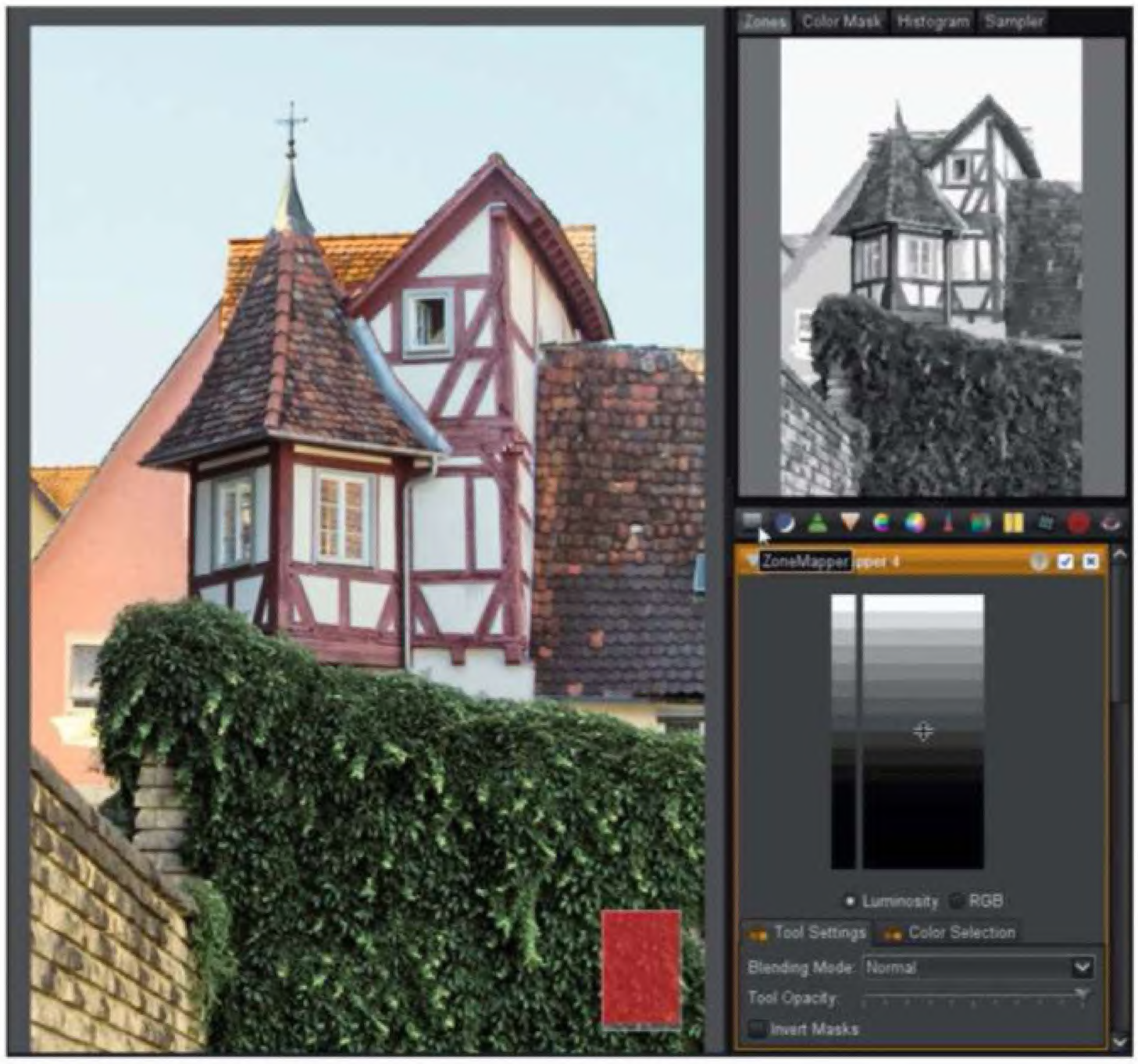
Capture One's Auto Mask feature is great for quickly masking clearly defined areas such as a uniformly colored building or a studio background. To activate Auto Mask, select the Brush icon in the Local Adjustments tool or the Cursor Tools toolbar and right-click anywhere in the preview window to open the context menu. Now check the 'Auto Mask' option. The cursor will show two concentric circles surrounding the plus sign. Zoom into the preview image and fill in the desired areas, but do not let the inner circle touch any areas you wish to omit from your selection.

The Auto Mask feature works best if you take your time and draw your mask using multiple short brush strokes. You can only actually see what you have drawn once you release the mouse button. If a brush stroke doesn't produce the desired effect, undo it using the Ctrl/Cmd+Z shortcut.

With *Capture One*'s Auto Mask feature, masking uniformly colored objects, such as the wall of this house, is quick and easy

Step-by-Step Guide to Burning in LightZone

The *LightZone* interface may seem strange to new users, but it doesn't take long to learn and is easy to use. This guide takes you through the steps required to apply a selective burn effect.



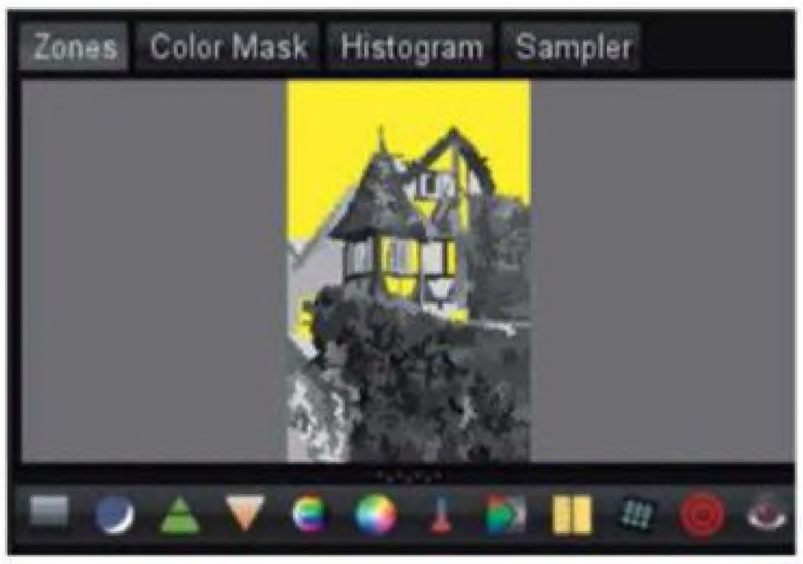
1 Begin by switching to the Zones tab in the top right-hand corner of the program window, then select the ZoneMapper tool (on the left beneath the preview window)

You can adjust the ZoneMapper settings now or after you have made your selection.

2 Select the 'Region Mode' option in the Modes toolbar and select an appropriate tool, such as Draw Polygon Region.

Now, every time you click in the preview image a new control point is created. Note that the outer of the two lines displayed while you draw represents the feathered edge of your selection, not its outline, which is denoted by the inner line. It is often simpler to draw a mask that omits your selection and then invert it. In our example, we have selected everything *except* the sky. You can then check the 'Invert Masks' option to invert your selection. There is no visual indication that a mask has been inverted, so take care when applying your own inverted adjustments.

Create a mask of the areas you *don't* wish to adjust and invert it



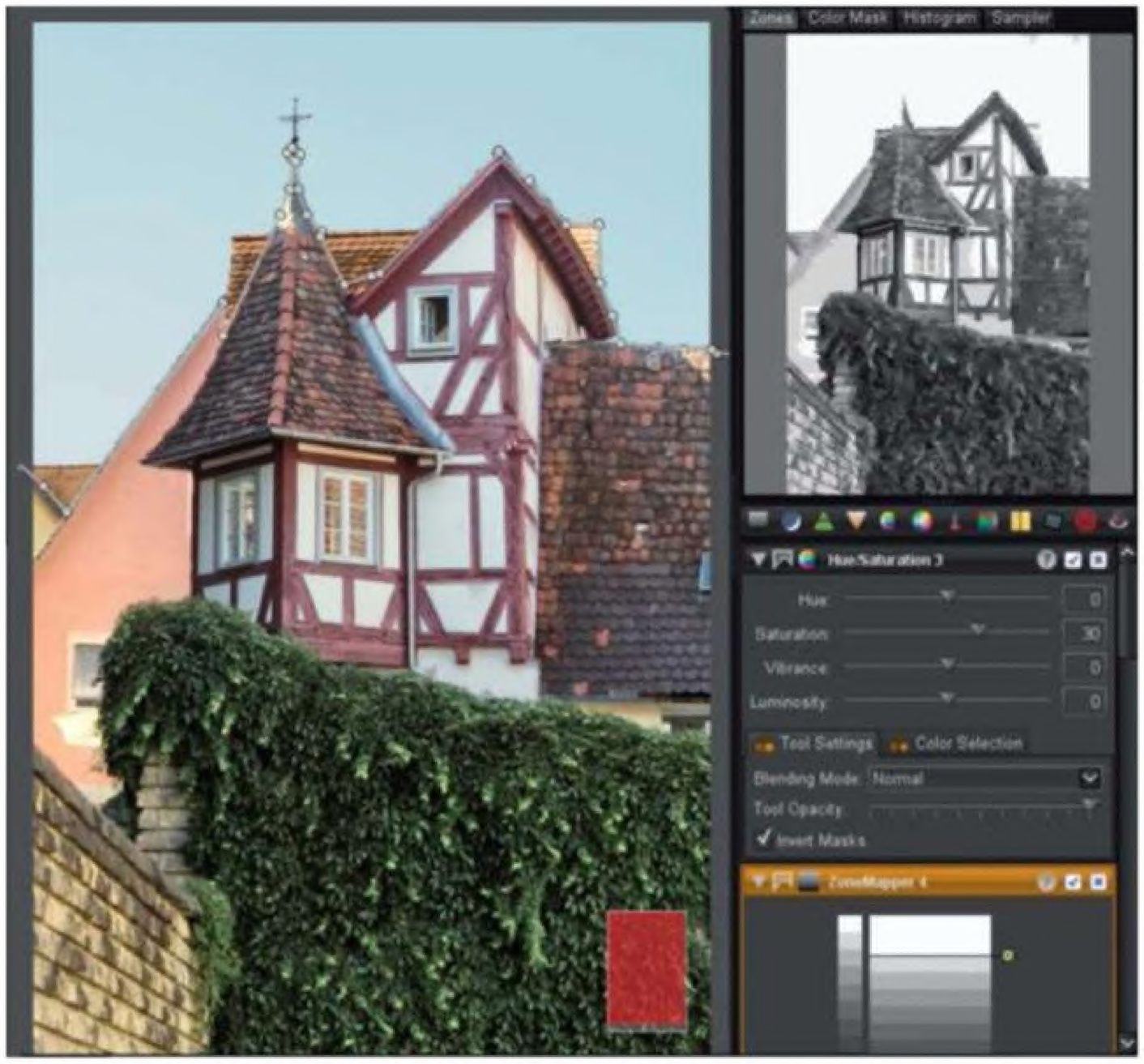
To burn (i.e., darken) the selected region, drag the edge of the appropriate zone downward

3 Moving the mouse over the ZoneMapper window highlights the zone in the preview image that matches the brightness at the current cursor position.

Once you have found the appropriate zone, drag its lower edge downward to darken your selected region. You can fine-tune the effect this produces by selecting a different blending mode.

4 To adjust the degree of feathering at the edge of the selected region, drag the inner outline toward or away from the outer one to enlarge it or make it smaller. If the edges and the control points are hidden, double-click anywhere within the mask to show them.

To apply your selection using a different tool, click on it and use the Ctrl/Cmd+C shortcut to copy it to the clipboard. Now select your tool of choice and use the Ctrl/Cmd+V shortcut to insert the copied selection into the new tool. Here too, you can select the 'Invert Masks' option if required. The two masks are linked, so any adjustments you make to one are automatically applied to the other.



Thomas Saur

Eagle-eye Cover Shoot

Today's new ultra-high-resolution cameras promise uncompromising sharpness, so we decided to use this issue's cover shot to portray the notion of 'sharpness' in all its many facets. The eyes of the birds of prey in these photos are the epitome of optical precision.

The hire company 711rent helped us select the right equipment for the job. We ended up using two 1′×4′ softboxes and one 4′×6′ softbox with various generators, flash heads, reflectors and other accessories. Photographer Thomas Saur used his Hasselblad H4D with an HC Macro 120mm f/4.0 lens that we also hired from 711rent.

The race is on: which manufacturer can build the most pixels into a full-frame sensor? The Canon EOS 5Ds, with its 50.6-megapixel sensor, promises full-frame sharpness comparable with that of medium-format cameras. It is this extraordinary level of detail and precision that we wanted to represent with this issue's cover photo, and what better subject than an eagle's eye to symbolize our vision.

Photographer and *c't* art director Thomas Saur found the perfect partner in the Bergisch Land Falconry Company (Falknerei Bergisch Land), which even provided the loft space where we set up an improvised photo studio.

We hung a 20′ piece of cloth in the background and used two 1′×4′ softboxes to produce lateral reflections in the birds' eyes. The main 4′×6′ softbox was positioned behind Thomas to give the head-on portraits a really three-dimensional look.

It is impossible to get large birds of prey to sit still for test shots, so Thomas had his assistant stand in while he checked the lighting setup.

During the shoot, we were priveleged to work with Grobi the sea eagle, Java the bald eagle and Brati the great gray owl. To achieve the ultra-precise detail rendition he was looking for in the photos, Thomas had to use flash, but he dialed the modeling lights right down to avoid subjecting the birds to unnecessary stress.

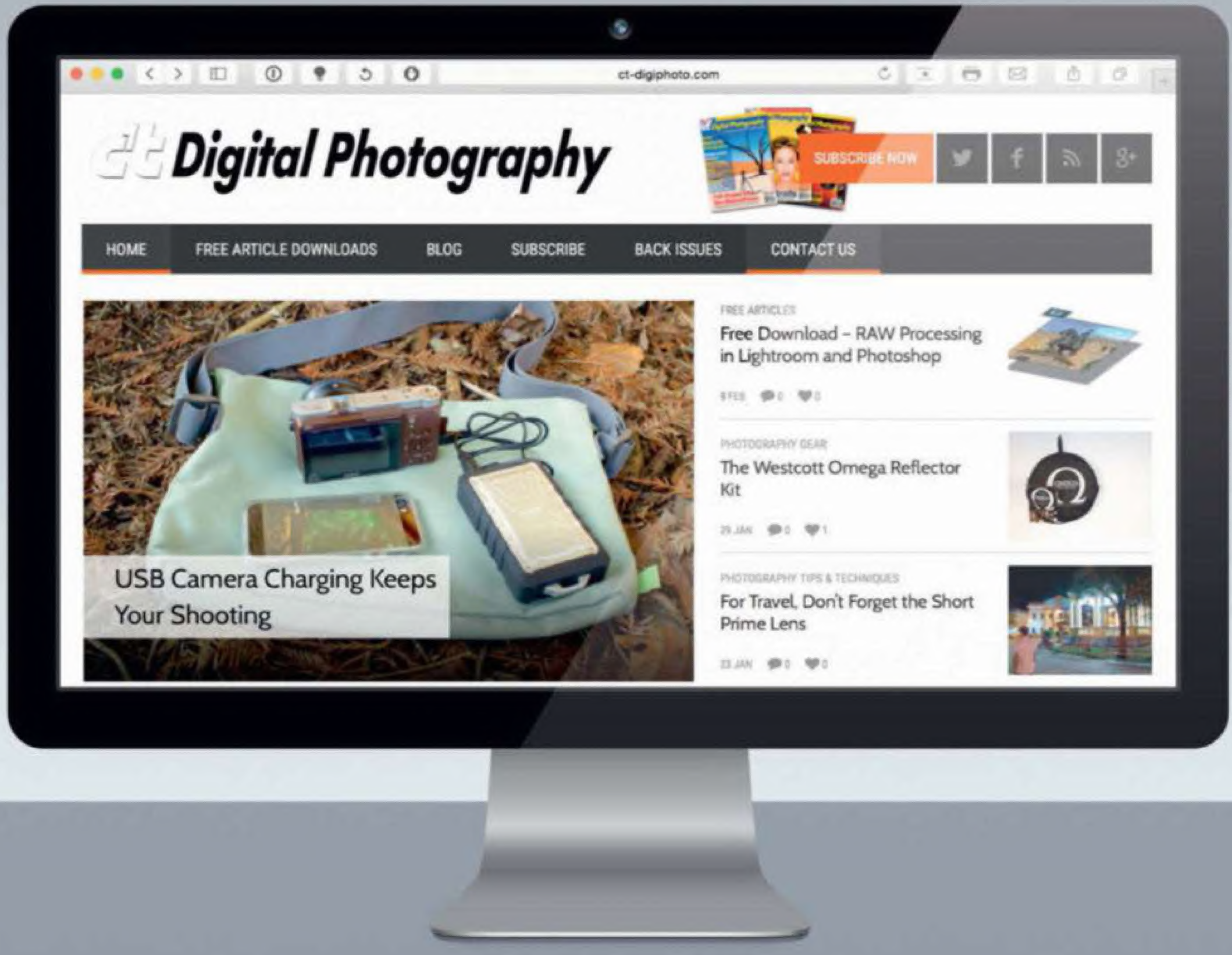
The falconer paid close attention to his birds and gave each one plenty of time to get used to the new environment in the studio before we began to shoot. Capturing the photos took only a few minutes, and Thomas stopped shooting the second any of the birds showed signs of agitation. If the falconer felt there was stress involved, he took the bird in question out of the room and we continued to shoot with one of our other 'models'. It is a credit to the close relationship he has developed with these creatures that he managed to get them to look in the right direction for the whole session.

In the end, we decided to use one of the images of Java the bald eagle for our cover. Java remained calm throughout the shoot and served up the perfect proud but laconic expression at just the right moment. (ssi)

Grobi the sea eagle taking a break. As a reward for their patience and star quality, the birds were fed delicious morsels of chicken throughout the shoot.

Brati the owl has extremely expressive eyes and unusual markings on his face. Because owls are highly sensitive to bright light, we kept his part of the session short.

Better captures are a click away!



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Jana Maenz

Discovering Landscapes through a 50mm lens

Shooting landscapes and nature photos using only a 50mm lens is an unusual idea. In this article, Jana Maenz demonstrates just how enriching such a self-imposed restriction can be. The photos shown here were all captured on a winter journey to the Baltic island of Ruegen, and each tells its own mystical story. As well as discussing her approach to photography, Maenz reveals how she uses Lightroom and Photoshop to add textures that give her images a unique and highly personal look.

Hibernate

Nikon D700 | 50mm f/1.4 | ISO 400 | f8 | 1/160 s | Detail

If you were to ask me which artists have influenced me, the first names I would mention are probably those of painters of the Romantic period like Caspar David Friedrich and William Turner. The central themes of the Romantic movement were love and longing, mixed with a dash of mystery, an almost fairy-tale atmosphere and the question of the role of the individual in such an idealized world.

I would love to have lived and worked back then, although I am really happy that I have access to a digital camera and image-editing technology to create photographs that reflect my innermost feelings.

Lightroom and *Photoshop* help me to add colors and textures to my photos that resonate with my soul, and the tools they provide enable me to retouch details that spoil the lighting or the feeling of longing I am trying to create. My photography involves much more than just mirroring reality.

This kind of artistic aspiration was omnipresent among the Romanticist painters, which explains why Friedrich's *Wanderer above the Sea of Fog* portrays a place in the German state of Saxony that never actually looked the way it does in the painting.

In this article:

Nostalgia
It is impossible to capture the movements of so many gulls in a single image. To convey a sense of fluttering action, I shot a sequence of images that I merged using *Photoshop*.

Nikon D700 | 50mm f/1.4 | ISO 400 | f5.6 | 1/100 s | Multiple source images merged in Photoshop

A Winter Journey

I had long dreamed of spending winter alone on the Baltic coast, and my wish at last came true in the winter of 2013. Winter comes early on the Baltic, and the Island of Ruegen was already covered in snow at the beginning of December. Large parts of the brackish lake in the center of the island were frozen over and the whole landscape appeared to be falling into a deep winter sleep, accompanied by the crying of the gulls. So there I was, alone in the midst of all this winter with my camera and a 50mm lens. I spent hours and hours wandering knee-deep through the snow in search of subjects that reflected my feelings.

Winter on Ruegen is unique. The endless beaches are completely empty and the streets of the island's spa towns, so busy and full of life in summer, are all deserted. All of the restaurants are closed too, and the only sounds are the ocean waves and the cries of the swans that spend the winter on the lake.

As the weeks rolled on, the island's birdlife took on a central role in my work. Birds represent freedom and effortlessness, but also embody order and continuity – attributes that complement each other very nicely. I tried to capture these characteristics while using a degree of deliberate blur to transform conventional images of birds into something more mystical and dreamlike. To achieve

Sea Buckthorn
In this scene, I wanted to capture as much as possible of the chalk cliffs in the background while retaining the ethereal glow of the berries in the foreground – a tricky task with a standard lens. I spent an entire afternoon walking up and down the beach until I found a spot where I could compose the image as I wanted.

Nikon D700 | 50mm f/1.4 | ISO 400 | f8 | 1/320 s

these effects, I shoot either long exposures or sequences of images that I merge together later. I take a highly intuitive approach to post-processing and work instinctively, always with my original vision of the finished image in my mind's eye.

One of the highlights of the Baltic winter landscape is the sea buckthorn bushes with their golden orange berries that appear to glow in the winter sun. They contrast beautifully with the white snow and the dark greeny-blue sea. The buckthorn bushes flourish all around Cape Arkona, giving the whole area an enchanted feel.

Jasmund National Park, a few kilometers further south, is full of beech trees whose trunks take on a magical silvery glow in the winter light and contrast beautifully with the reddish-brown leaves that cover the forest floor. The park's snow-covered chalk cliffs provide another fantastic vista in the setting winter sun.

Another place I will always remember is the frozen brackish lake on the Moenchgut Peninsula. I crossed the fields through drifting snow and was confronted with the breathtaking sight and sound of thousands of aquatic birds that spend the season on the island singing their melancholy winter melodies.

Winter on Ruegen is full of such wonderful surprises, all of which make great photographic subjects. The landscapes give you energy and provide endless inspiration too.

My Passion for 50mm Lenses

When I began shooting nature and landscape photos in the mid-1990s, I was convinced that I needed a wide range of lenses and other accessories to capture the images I wanted. I bought more and more gear, and my camera bag became heavier and heavier. I flew all over the world and photographed everything I laid eyes on. The results were very nice, but that's all they were.

Many years passed before I began to free myself of the ballast of excess equipment. It was during this period that I rediscovered my 50mm f/1.4 lens, and it definitely wasn't love at second sight. Most of the first hundred photos were blurry and focus never seemed to be where I wanted it. Nevertheless, the lens got my creative juices flowing and I was really excited by the extreme clarity and sharpness of the images that worked out as planned. I began to understand the lure of lenses with a fixed focal length.

People often ask me what I like so much about this lens – after all, it appears unspectacular and inflexible. In fact, the opposite is true. It is small, light, unobtrusive, quiet and fast, and its large maximum aperture makes it ideal for creating wonderful bokeh effects. At the other end of the aperture scale, it is great for creating starburst effects (see page 127). Most importantly, it produces really sharp details. So this lens has become my favorite and virtually the only one I use.

At the same time, I began to think differently about photography. I know the view through my 50mm lens so well and I am now so good at estimating subject distances that I can see my compositions in my mind's eye by force of imagination alone. It is, of course, a great help that the perspective projected by a 50mm lens is almost identical to the view perceived by the human eye. I compose my images in my head and set the aperture and exposure time instinctively. This process brings my subject, my emotions and my affinity for technology together in a single act. I couldn't have imagined working this way just a few years ago.

Sticking to a single focal length has opened up a whole new world of creative possibilities, and I can count on one hand the occasions when I wished I had taken along a macro or wide-angle lens.

When I showed my portfolio to a friend not long ago, he found it hard to believe that I had captured all the photos using a 50mm lens. The idea was obviously strange to him and he was amazed at the degree of creativity this approach affords. He also asked when and how I find my subjects.

Never Stop Looking

The secret to finding great subjects isn't really a secret at all. All you need is time and some observational skills. On average, one in every five of my trips produces usable results, so I often revisit locations at different times of day or in different weather – even in rain and fog when other photographers probably stay at home.

To give myself time to experience and capture the huge range of moods the island of Ruegen offers, I spent two months there. Ocean landscapes change all the time. Even when I revisit a known location, I try to think freely and capture new subjects and angles that I hadn't seen before. I often capture multiple shots of the same subject at different times and compare them on my computer later to see which I like best.

Don't get me wrong – I don't completely ignore technology. All the photos in this article were captured using a full-frame Nikon D700 and an AF NIKKOR 50mm f/1.4D lens. I am sure you are thinking that an f/1.8 lens would do just as well, but I find the extra stop a great aid in low light situations and very useful for portrait shots. The results quickly make up for the extra expense!

The f/1.4 lens is also ideal for creating bokeh effects. I love the softness and shape of the patterns it produces. The very best bokeh comes between f1.8 and f3.5, but this particular lens also produces beautiful flares at narrow apertures. Last but not least, it feels

Flotsam
This photo was captured at maximum aperture. The sun is reflected and refracted in the waves in the background, creating a sea of bokeh.
The shape of the individual light spots depends on the shape of the diaphragm in the lens you use.

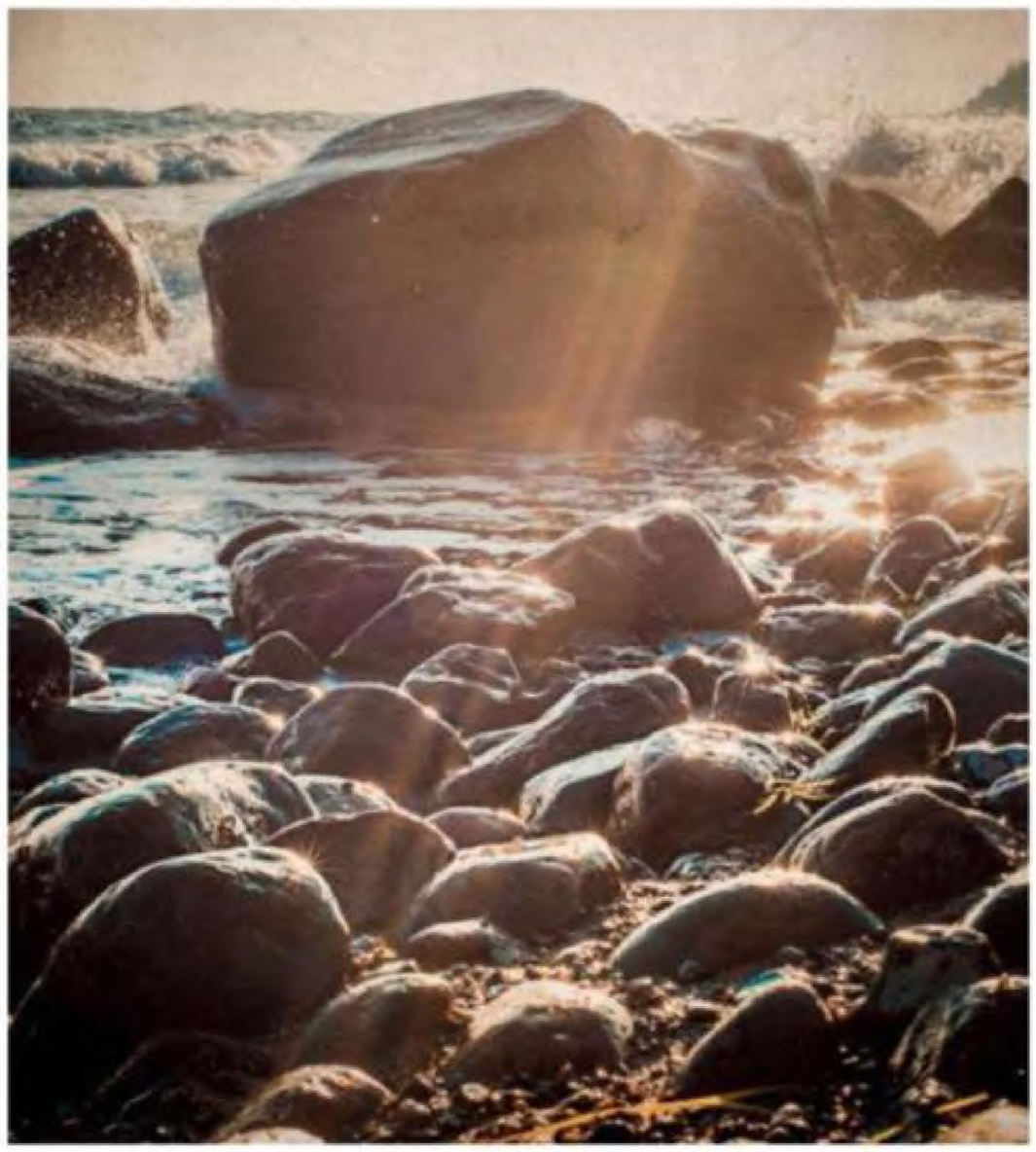
Nikon D700 | 50mm f/1.4 | ISO 400 | f3.2 | 1/2000 s

Capturing Flares

To make deliberate use of flare or 'starburst' effects, you have to stop your lens all the way down. The best effects occur between f11 and f16. The resulting patterns depend on the number and shape of the aperture blades in your lens. My 50mm NIKKOR has seven blades arranged in a polygonal shape that produces 14-point stars.

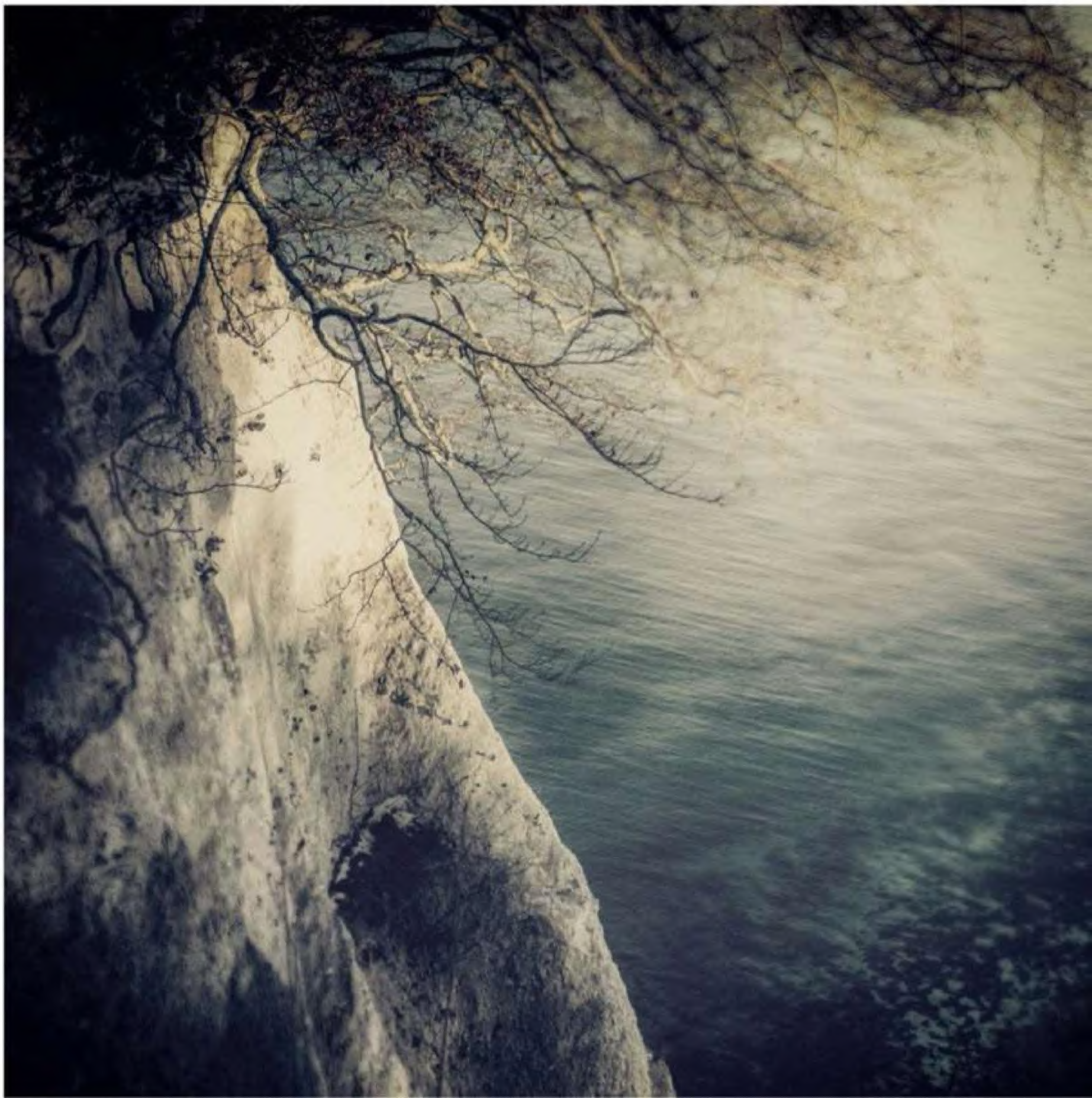
Flares are caused when light entering the lens is refracted by the edges of the aperture blades. The angle of refraction depends on the aperture setting – the smaller the aperture, the more light is refracted and the larger the resulting starburst. The deciding criterion is not the f-number but the absolute size of the aperture opening, which depends on the focal length of the lens.

Starbursts are especially effective in high-contrast situations. Bright light against a dark background is ideal – for example, a street lamp against the evening sky.



Ocean Stars
You need to be prepared to experiment if you want to capture flares. For this shot, I stopped down to f16 and lay on the ground to shoot directly into the light. The way the water refracts the light enhances the effect.

Nikon D700 | 50mm f/1.4 | ISO 400 | f16 | 1/500 s



Cliffs
The chalk cliff known as 'The King's Chair' is one of the most popular photographic subjects on the whole island. Because my 50mm lens doesn't have a large enough angle of view to cover the whole subject, I decided to concentrate on a detail.

Nikon D700 | 50mm f/1.4 | ISO 400 | f16 | 1/40 s

great to use. The build quality is great, with plenty of metal components hidden under the plastic exterior.

The key attribute of this lens is its sharpness. Time and again – and especially in portrait shots – the 50mm f/1.4 produces marvelously crisp, three-dimensional-looking images. I discovered this unique characteristic while I was still using my DX-format D90, and the effect is even better now that I use the lens with my full-frame D700.

In spite of all this praise, there are still drawbacks to using a lens like this. If you are just starting out shooting with a fixed focal length lens, you will probably find that many of your photos turn out blurred. This is often because the diopter adjustment in the viewfinder doesn't match your eyesight. If you are shooting from a tripod using live view, the monitor zoom function is a great aid to accurate focusing. However, using a tripod is too complicated in many situations, so you simply have to learn to focus carefully. Because correct focus often depends on just a couple of millimeters difference, I often take multiple shots of my subjects with different focus settings.

The Effect of the ISO Setting

The ISO setting you use is important too. I generally stick to ISO 200, but sometimes use ISO 400 or 800 on dull days. I only occasionally use higher values because they reduce image quality and increase the amount of noise. Noise can, of course, be reduced at the post-processing stage, but the results are never perfect. At ISO 2000, even the Nikon D700, with its moderate noise characteristics, produces noise that is virtually impossible to eliminate digitally.

Denoising also softens images and makes them look unnatural. This is especially true of portraits. In tricky lighting, I either use a tripod or stick to the maxim noted by photographer and writer Andreas Feininger, who said that when it comes to shooting in poor light or with non-photogenic subjects, the real art lies in *not* pressing the shutter button.

I find it fascinating that my first lens has turned out to be my favorite after all those years of turning my nose up at fixed focal lengths. I occasionally use 60mm or 100mm macro primes, but the switch from crop format to full-frame was the trickiest visual reorientation of all. Suddenly, although I was still shooting at the same distance, my subjects appeared further away. However, the close focus distance remains the same and, with a few weeks' practice, I learned to handle the new camera without losing any of my creative drive.

Capturing Panoramas

To compensate for the lack of a wide-angle setting, I often shoot panoramas with my 50mm lens. If the ambient light allows, I shoot handheld and do without a tripod or a dedicated panorama head.

I activate the viewfinder grid and continuous shooting mode and manually select the aperture and focus setting (infinity for landscapes). I then check the scene and identify where I want to place the horizon within the frame. Once I am satisfied with the setup, I shoot my panorama in portrait format (i.e., with the camera held vertically). I rotate my body around the camera's axis while making sure the horizon doesn't shift within the frame. It take a little practice to shoot in one smooth movement.

My panoramas usually consist of between 8 and 16 portrait-format raw source images (sometimes in two rows) that overlap by about 50 per cent. I process my images in *Lightroom* so that there are no visible joins when I use the Edit In > Merge to Panorama in Photoshop command.

I don't think in 16:9 or 21:9 formats when I am shooting panoramas. Especially when I shoot two- or three-row panoramas, I try not only to show the landscape as I see it, but also to produce a finished image with a quality that is way beyond what I could produce using a wide-angle lens. I often print my images at 3'×3' or larger and use them as wallpaper. In situations like these, you can never have enough pixels.

Image Processing

Because I shoot raw, image processing is an integral part of my imaging workflow. I don't usually stop at correcting just exposure, contrast, noise or perspective errors either. Photography is about more than just pressing the shutter button at the right moment, and I always try to express my feelings in my images as well as drawing attention to the darker, misty side of life. Modern image-processing software gives me the tools I need to express these feelings visually.

I use *Lightroom* presets to give my images the colors and moods I am looking for and *Photoshop* to add textures that give them a kind of 'used' look. I like to use tilt effects to guide the viewer's eye to a specific detail and to transform the rest of the frame into pleasantly fuzzy meaninglessness. Modern editing tools also allow me to eliminate details that distract the viewer and get in the way of the rambling sweep of my romantic notions.

Shooting raw gives me material that I can develop into the works of art that my imagination conjures up. I don't edit images for the sake of special effects but to express myself and make an impression on the viewer. Photography is about much more (or perhaps much less) than just recording reality.

At the End of the Day

My sojourn on Ruegen was over all too quickly and nothing seemed to have changed in the daily routine at home. Two years later, I still notice how the trip has influenced me and the way I see things. I need much less stuff and I am clearing out my apartment to make room for new ideas. I really don't need anything other than my camera and my 50mm lens to capture the images I want.

I now understand why Cartier-Bresson used only a 50mm lens for his personal photography. It's not about cameras or lenses but about creativity, and the self-imposed limitation of using just one lens has given my creativity a big boost. I now have to think much more than I did when I had a zoom ring to play with. I have to work hard on my composition and get to know my subject intimately before I can find the right viewpoint, even if conditions are less than ideal. (pen)

Jana Maenz

Jana Maenz was born in Halberstadt, Germany in 1976 and discovered photography while studying geography. She began her career as a multimedia journalist and now works as a freelance artist, photographer and author.

For more on her work, visit www.jana-maenz.de

Old Trees
The island of Ruegen is famous for its tree-lined boulevards that look gorgeous in summer and spectacular in winter. This image captures the wonderful detail in the gnarled, snow-covered branches and twigs. The empty space on the left-hand side helps to convey a sense of calm and emphasizes the stillness of the winter landscape.

Nikon D700 | 50mm f/1.4 | ISO 400 | f8 | 1/800 s


36
16
S-200
16A
36
36
16
16A
16
16A
16

Thomas Gade

How to get great colors from

Digitized Negatives

Digital cameras are ideal for digitizing negatives, but converting digitized negatives into positive images involves hard work and specialist skills. Simply inverting the tones in a negative produces strange-looking colors that have little to do with the original scene, partly because of the orange mask used in most color negative films. However, with the right knowledge and tools, you will be able to deal with it effectivley. This article looks at the pros and cons of using raw converters, Photoshop, plug-ins and scanner software to get converted digitized negatives looking as good as the original prints.

When it comes to digitizing negatives, a high-end digital camera is just as good as a scanner, producing resolution and sharpness that leave nothing to be desired. However, color negatives have a translucent orange mask that covers the entire frame and are comprised of tones that are the inverse of those in the original subject. Digital cameras are not equipped with tools for transforming negatives into positive images with genuine-looking colors.

Getting the colors right involves extreme color corrections, so you need to shoot raw if you want to successfully convert digital negatives.

We don't know of any image-processing application that has built-in tools for converting digitized negatives. The first of the several steps in the process is to invert the tones using a raw converter, and Corel's *AfterShot Pro 2* is the only one we know of that has an 'Invert' button. You can use presets to perform the same task in most raw converters, but becasue the brightness, contrast and color adjustment tools in conventional image-processing and raw-conversion applications are designed for use with images that contain 'normal' colors, they are not much use when converting negatives. If an image has too strong a blue component following inversion, using the blues slider to desaturate the appropriate tones has little or no effect. To get your colors back on course you have to adjust the complementary color of the tone you are looking at and, to adjust image brightness, you have to shift the sliders in the opposite direction to the one you are accustomed to. All of these steps take some getting used to, and some photographers find it easier to make a 16-bit TIFF copy of a digitized negative and process it in *Photoshop*. Manipulating tone curves in *Lightroom* is trickier than in *Photoshop* or *ACDSee*. The Tone Curve tool's panel is relatively small, making it difficult to drag the curve precisely to the right position. *Lightroom*'s color channel display can also be difficult to work with. The colors are displayed with little saturation and it is difficult to differentiate them from the background. All in all, *Lightroom* is less suitable for converting negatives, so the following pages use *ACDSee Ultimate 8* to demonstrate the conversion process.

Using a camera and a raw converter is fine if you only occasionally need to copy and convert a negative, but if you want to convert multiple originals, you'll need an automated process. See page 135 for details on how to do this using the *VueScan* scanner software package and *Silverfast HDR*.

Converting Negatives with a Raw Converter

It is extremely difficult to imagine what the positive image will be like when you are looking at a color negative. As well as containing inverted colors and brightness levels, negatives are covered with a yellow, orange or brownish mask. The color of the mask is always the same for a single type of film but, over the years, manufacturers produced many different films with very different emulsions and mask colors.

Color film has three basic layers of emulsion, which are sensitive to red, green and blue light. During development, the silver halide crystals in the emulsion are replaced with colored dyes, creating a yellow-colored layer for the blue tones, a magenta-colored layer for the green tones and a cyan-colored layer for the red tones. Over time, these dyes bleach out and the corresponding color density curves change accordingly. Each color layer bleaches at a different rate, producing color shifts and, in extreme cases, complementary color casts in highlight and shadow areas.

Many surviving color negatives are several decades old and already significantly bleached. Today's digital image-processing tools are great for repairing bleached-out colors, although damaged negatives can be extremely difficult to restore.

Unlike the composite RGB curve used to invert black-and-white negatives, the three color channels in a color negative are inverted using separate red, green and blue curves. Note that the RGB curve itself is not inverted during this process.

Inverting a color curve involves raising the black point and lowering the white point to convert the white point to black and the black point to white. All the tonal values between these two extremes are also inverted. If you manage to invert the RGB curves in *Lightroom* to your satisfaction, save yourself some effort in future by saving your settings as a preset.

Unknown 1970s Fujicolor color negative film. The bleached-out dyes have produced complementary color casts.

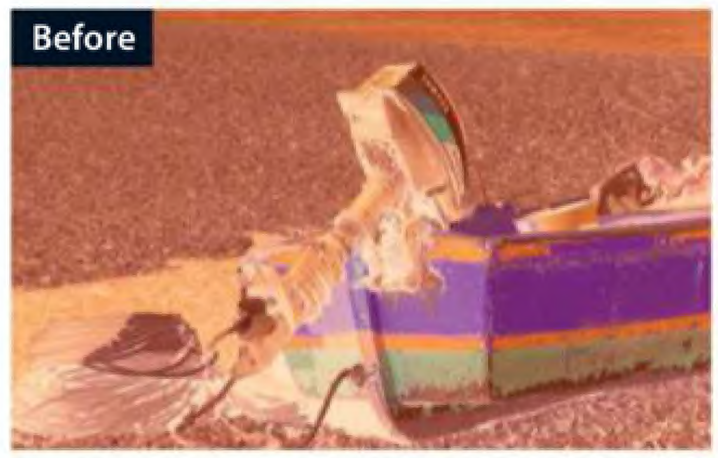
Fuji Superia 200 color negative film is still sold. The effect of its color mask is relatively easy to counteract during the digitization process.

Agfa CN17 was introduced in 1956 and was the last unmasked color negative film Agfa ever produced. These negatives can be used to create color or black-and-white prints.

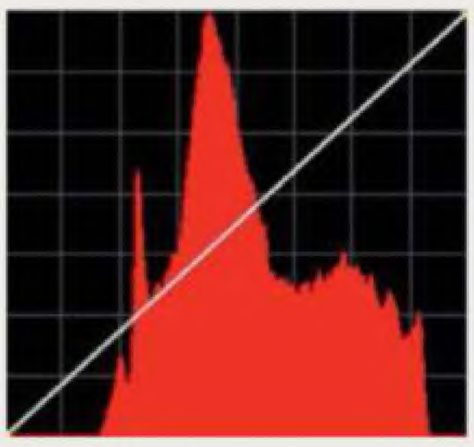
Kodak Ektar 25's extremely fine grain structure made it popular in the 1990s. It has very high contrast but the colors are difficult to reproduce digitally.

ACDSee Ultimate 8

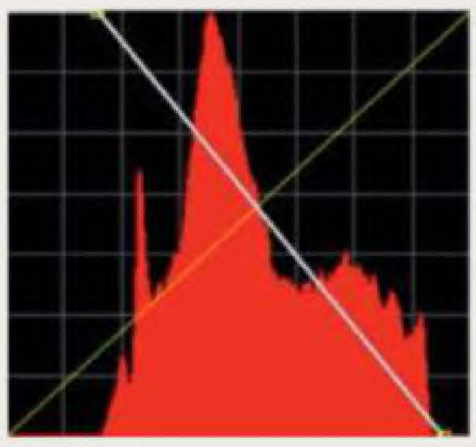
ACDSee Ultimate 8 **has a better tone curve tool than *Lightroom*, with RGB curves that are easier to see and manipulate. Here, we demonstrate the processes involved in converting a color negative to positive. The steps themselves can be applied using any image-editing program.**



1 Invert the red channel. The black point is raised as far as possible and adjusted to coincide with the far left-hand end of the histogram curve and the opposite is applied to the white point. Increasing the dynamic range for each curve eliminates color casts caused by the film's mask.



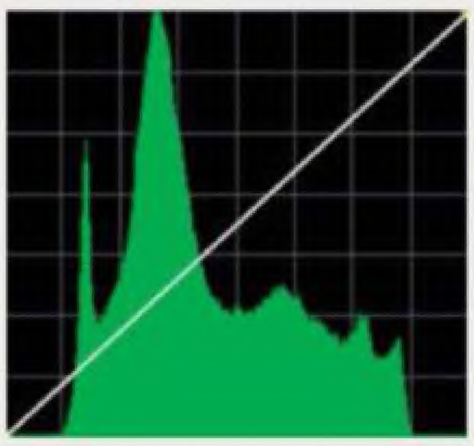
Original red curve



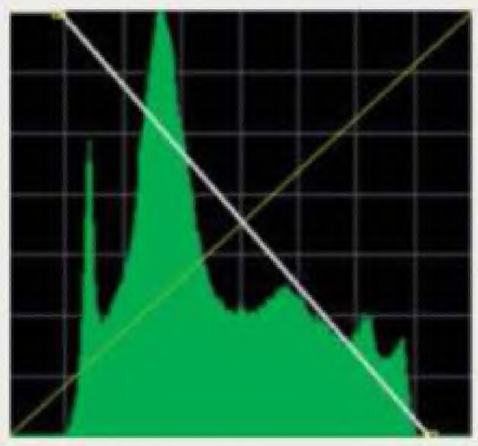
Inverted version

First inversion = strong color shift

2 Invert the green channel. Adjust the curve as in step 1 above. At this point, the positive image starts to appear.



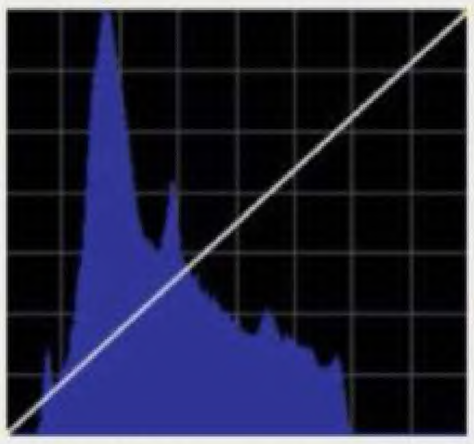
Original green curve



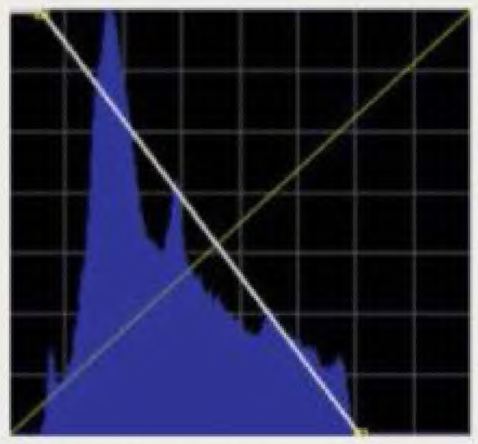
Inverted version

The positive image begins to appear

3 Invert the blue channel. Proceed as above. The base conversion is now concluded, but fine-tuning is still required to remove the blue cast from the positive image.



Original blue curve



Inverted version

The finished inversion

4 Tweak the tone curve to fine-tune the colors and brightness levels.

The corrected version still has a slight blue cast in the shadows, but this can be eliminated by applying a selective color correction in *Photoshop*.

Lower the center of the blue curve

This reduces the strength of the blue component

Raise the center of the red curve

This strengthens the red tones

Lower the center of the RGB curve

The final brightness adjustment

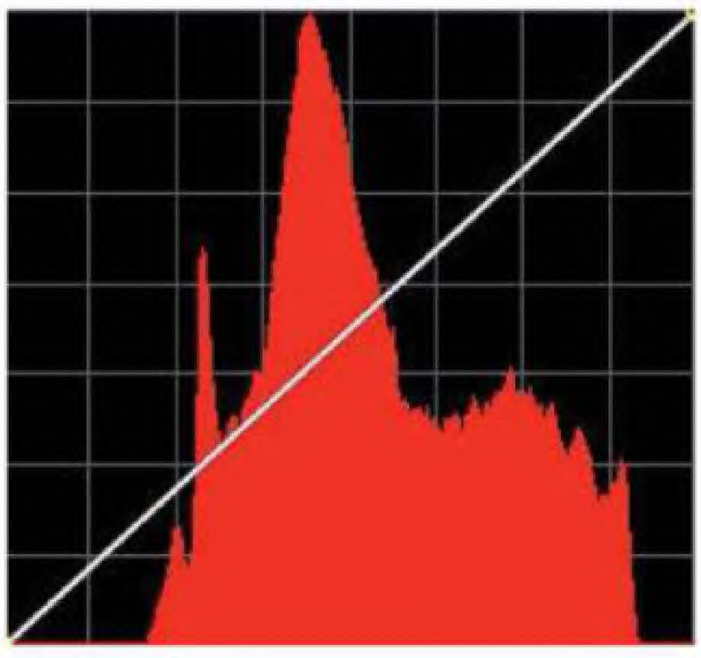
Adobe Lightroom 6

In principle, Adobe's in-house raw converter is a great tool for converting color negatives. However, its poorly developed tone curve tool makes inverting individual color channels trickier than it is in *Photoshop* or *ACDSee*.

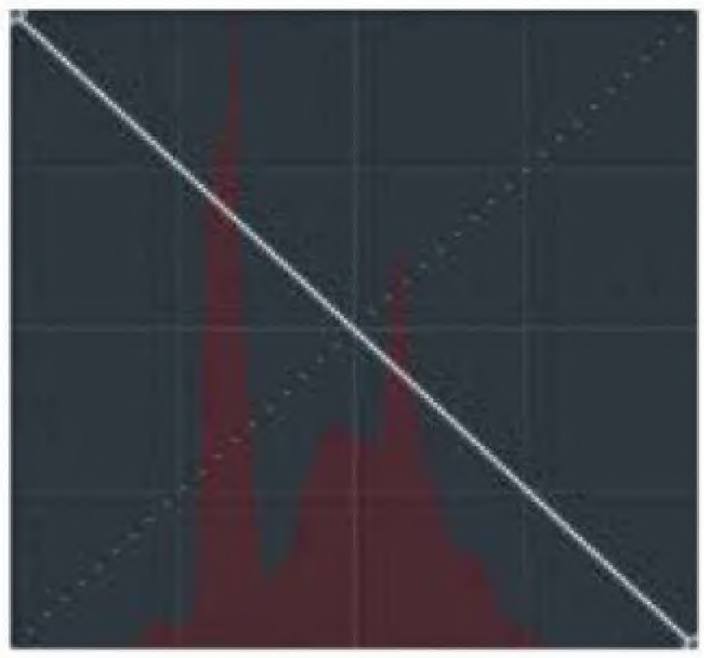
The same basic process that we demonstrated on the previous page applies if you want to use *Lightroom 6* to convert digitized negatives. The Develop module displays the negative, the histogram and the Tone Curve tool, and the first step is to invert the curves for all three color channels. Once you have made the appropriate settings, you can save them as a Develop preset for one-click application to other negatives.

Having inverted the curves, drag the black point to the left-hand end of the histogram and the white point to the right-hand end. This redistributes the tonal values within the image to fill the entire spectrum between black and white.

Inverting the curves changes the relationships between the peaks and troughs in the RGB histograms, which is why the positive image has a color cast. Dragging the curves into shape so that the peaks and troughs coincide reduces the effects of unwanted color shifts. You can further tweak the color balance by using the White Balance Selector (in the Basic panel) to select a neutral gray reference area. If you pick the right spot, all of the colors in the image should take on a more natural look. Use the Temp slider to fine-tune your result. This is all you should attempt using *Lightroom*'s tools – if more complex adjustments are required to achieve the color you are looking for, you are better off switching to *Photoshop* with its more powerful toolset.



ACDSee Ultimate
The tone curve tool's display shows each color channel clearly



Lightroom
Pale curves against a dark background make accurate assessment impossible

Photoshop, Digital ROC and ColorNeg

***Photoshop* is well suited to converting negatives, although some tasks are easier to perform using specialized plug-ins.**

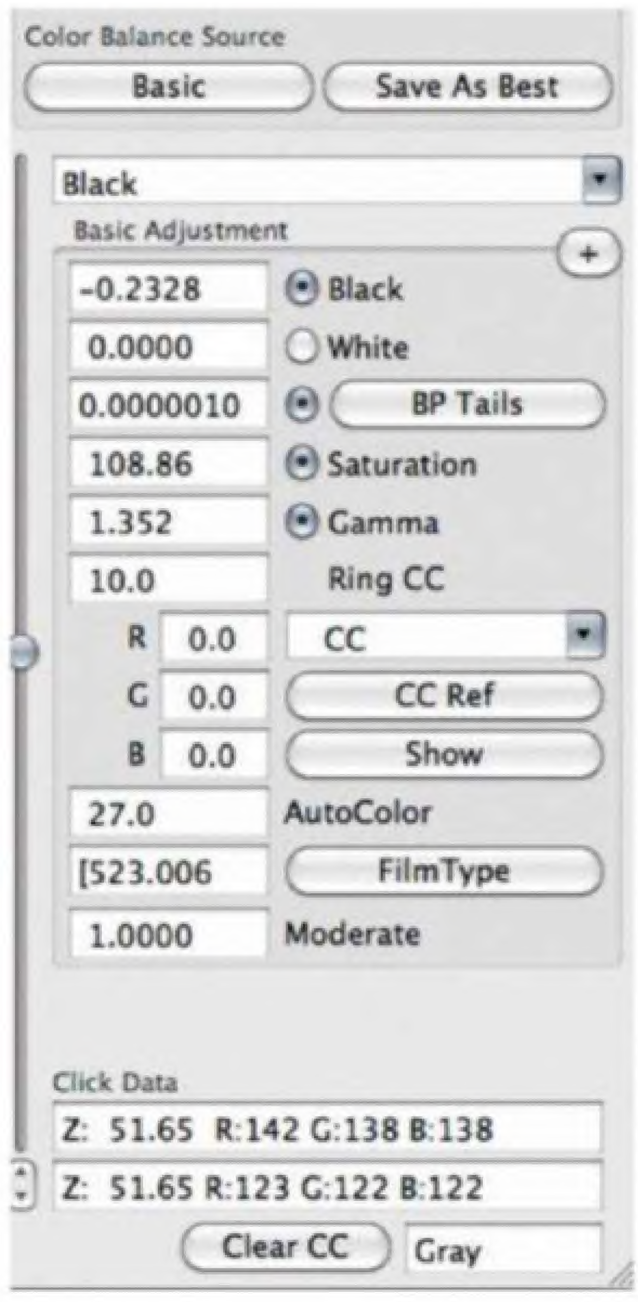
Today's raw converters offer a wide range of useful tools, but *Photoshop* and similar specialized image-processing programs still have a broader selection of tools that are often easier to use. There are also many dedicated conversion plug-ins around, such as *ColorPerfect* and Kodak's *Digital ROC*.

ColorPerfect is a *Photoshop* plug-in ($67 at www.colorneg.com) that includes the *ColorNeg* conversion tool, which is great for converting digital copies of color negatives. The plug-in interface offers a bewildering array of variables that take a fair amount of learning for beginners but may be familiar to more experienced users. Nevertheless, it won't do any harm to check out the developer's website, where you will find comprehensive instructions on how to use it and also on converting color negatives in general. Once you have learned your way around its controls, *ColorNeg* can be used to produce positive images with very good color rendition.

The Kodak *Digital ROC* plug-in is designed for removing color casts. It was introduced in the year 2000, works only with 32-bit versions of *Photoshop* and still offers unbeatable automatic color cast correction functionality. Unfortunately, no 64-bit version was ever developed, but most *Photoshop* installations can be run in parallel as 32- or 64-bit applications.

Our tip when using *Digital ROC*: to avoid unwanted clipping, enter the value 0.001% in the *Black Clip* and *White Clip* boxes.

The basic conversion steps can be automated using *Photoshop* Actions, but you have to enter your correction values manually when *ColorNeg* starts up. Automated processing continues once you have confirmed your settings.



***ColorNeg* has a vast number of variables and they are not intuitive to use, so it is more suitable for experienced users**

Batch Conversions using Scanner Software

The techniques discussed so far are fine for converting individual negatives but dedicated scanner software is a much better solution if you have a large number of originals. The problem with scanner software is that it is not usually capable of processing raw image data and even the applications that claim to be able to do so usually produce poor results. This makes it necessary to perform the intermediate step of converting your raw files to TIFF before processing them with a scan application such as *VueScan*. Converted TIFFs tend to produce positive images with unnatural-looking colors and thus require further color correction.

MakeTiff and Others

We came across *MakeTiff* during our research into *ColorPerfect*. *MakeTiff* converts raw originals to the Linear TIFF format, which can be used to produce high-quality positives. You can download a trial version from www.c-f-systems.com, and owners of a *ColorPerfect* license can use the full version for free. Other programs that can create linear TIFFs are Canon's *RAW Image Converter*, *BreezeBrowser*, and the *RAWDrop* and *cPicture* freeware packages, which are based on the open source *dcraw* module. *dcraw* is something of a raw conversion standard that can be found in many free and commercial raw conversion programs, but what makes *MakeTiff* unique is that it combines the *dcraw*, *ExifTool* and *tiffsplit* utilities in a single package. Used together, they produce the best possible raw material for conversion using scanner software.

MakeTiff is simple to use. To create linear TIFF copies of your files, open the application and drag the files you wish to convert to the program window. The program works much faster if you copy your originals to a hard disk first, rather than dragging them straight from your memory card.

Programs that can open conventional TIFF files but cannot read linear TIFFs will change the filename extension to *.tif*. Borders can falsify the colors your conversion utility produces, so remember to copy your negatives without them.

Converting with VueScan

The *VueScan* scanner software is compatible with many, but not all, popular raw formats, and results are often influenced by incorrect colors in the original negatives. Nevertheless, it works well with linear TIFF files, and it takes only two or three steps to produce great-looking positives. The first step is conversion of the raw originals to linear TIFFs, followed by conversion in *VueScan* and, if required, a final round of tweaking and optimization in *Photoshop* or some other image-processing application. Although the three steps cannot be linked to form a single batch process, the individual automated steps still save you a lot of work.

If you want to convert all of the files in a folder using *VueScan*, use a wildcard in the Input tab, for example: *C:\raw_originals*.tiff*. If you don't do this and the files are not numbered sequentially, the batch process will halt.

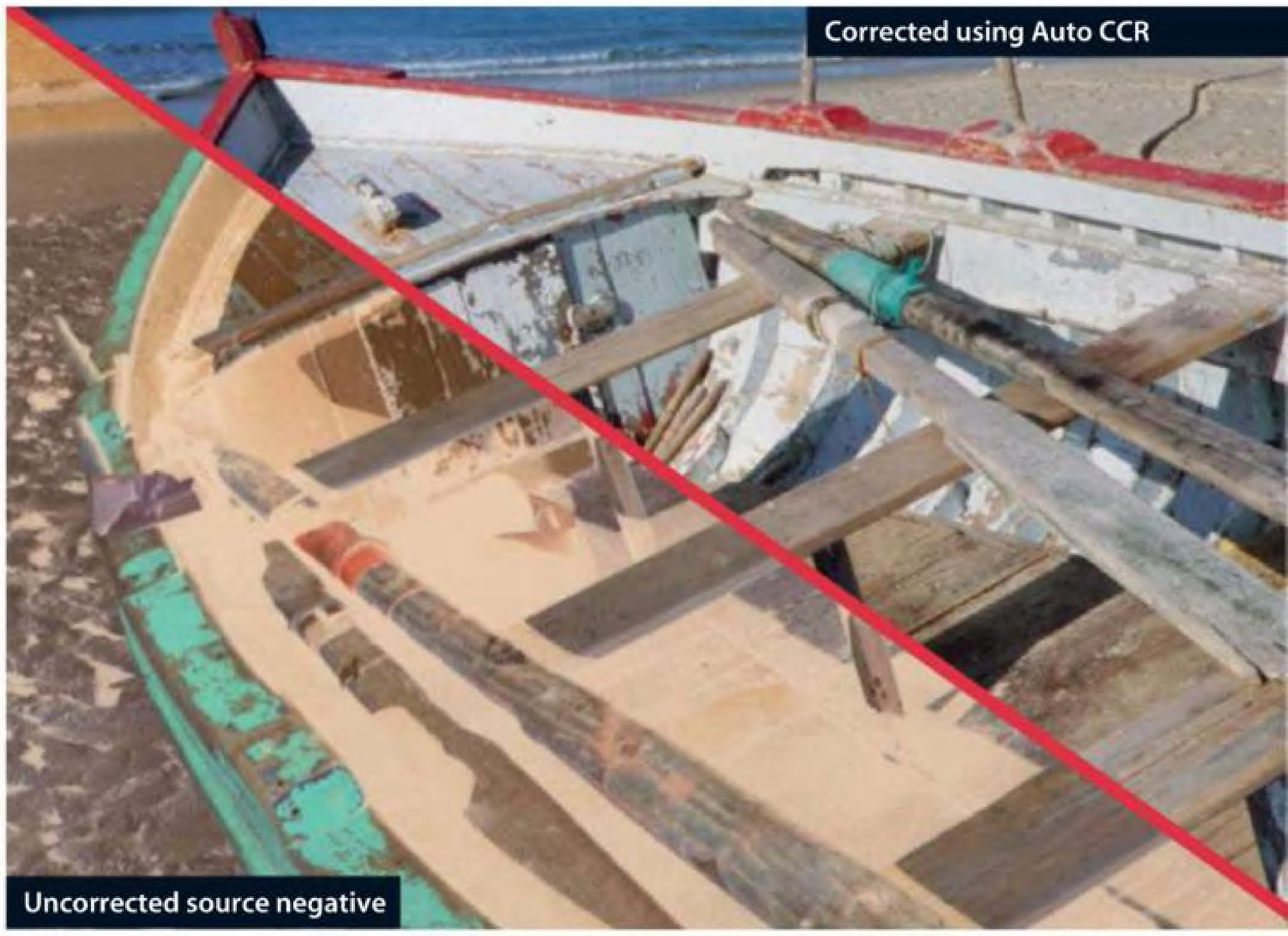
The 'Restore fading' option in the *VueScan* Filter tab works very well, but use the 'Restore colors' option with caution, as it sometimes produces unpredictable results. Set the Color Balance option to 'White balance', the black point to 0.001% and the white point to 0.5%. Using greater values increases the risk of a loss of detail in the highlights and shadows.

Select the 'Maximum' option in the Crop tab. Borders in your originals can disrupt the interpolation process, but setting the Buffer value to 10% excludes the edges of the frame from the program's internal analysis.

Linear TIFFs have a green base tone and are extremely dark, so TIFF files are usually gamma corrected for display to produce a positive image with natural-looking colors

SilverFast HDR

Considered by many to be the best of its kind, the *SilverFast* scanner software package includes precisely the right tools for the processes described here. The standard *Silverfast* application is available in custom versions for various scanner models, which are no use to us at this juncture, but the *HDR* version ($249) is designed for processing raw files from all manner of scanners. While it cannot process camera raw files, it can interpret linear TIFFs and produces usable positive images using its default settings. We recommend activating the Auto CCR color correction feature, which provides plenty of options and often produces results that are visibly superior to those you can create using raw converters. You can save successful settings and apply them to other images of the same film type using the JobManager tool which, unfortunately, is not particularly intuitive to use.



SilverFast HDR
The Auto CCR feature produces positives with natural-looking colors

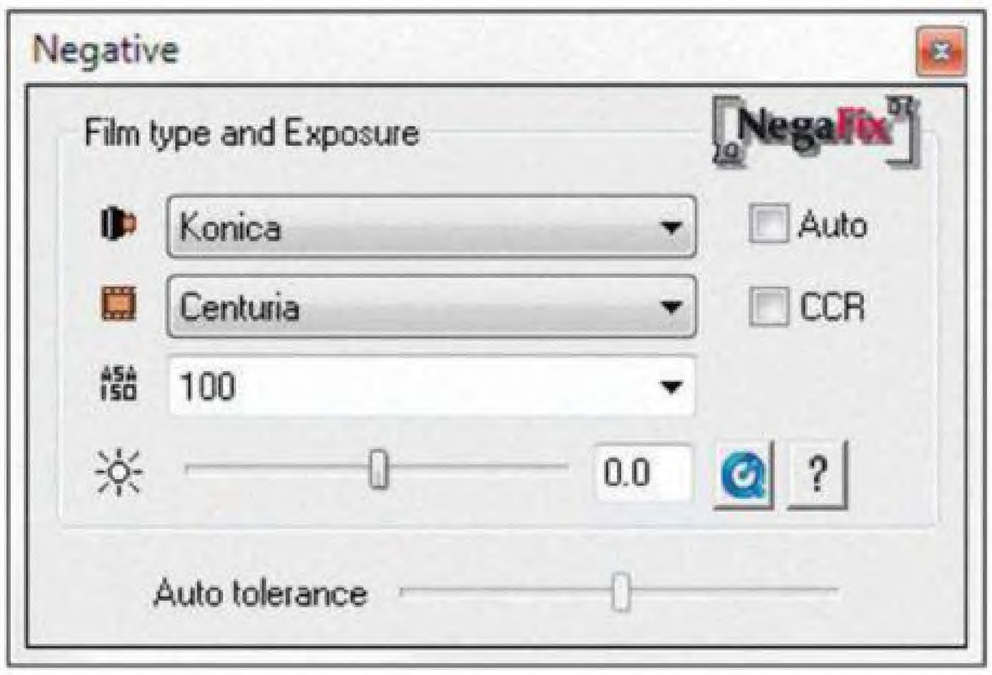
Conclusions

Raw converters, *Photoshop* and dedicated plug-ins provide all the tools you need to produce great conversion results. If you take this approach, using presets and *Photoshop* Actions helps take the donkey work out of the conversion process.

If you need to convert large numbers of files, you are much better off using *VueScan* or *SilverFast*, as these programs are specifically designed with negative conversion in mind. *SilverFast* has the best automatic color cast correction currently available and more fine-tuning options than *VueScan*. (sts)

The Pros and Cons of Using Film Profiles

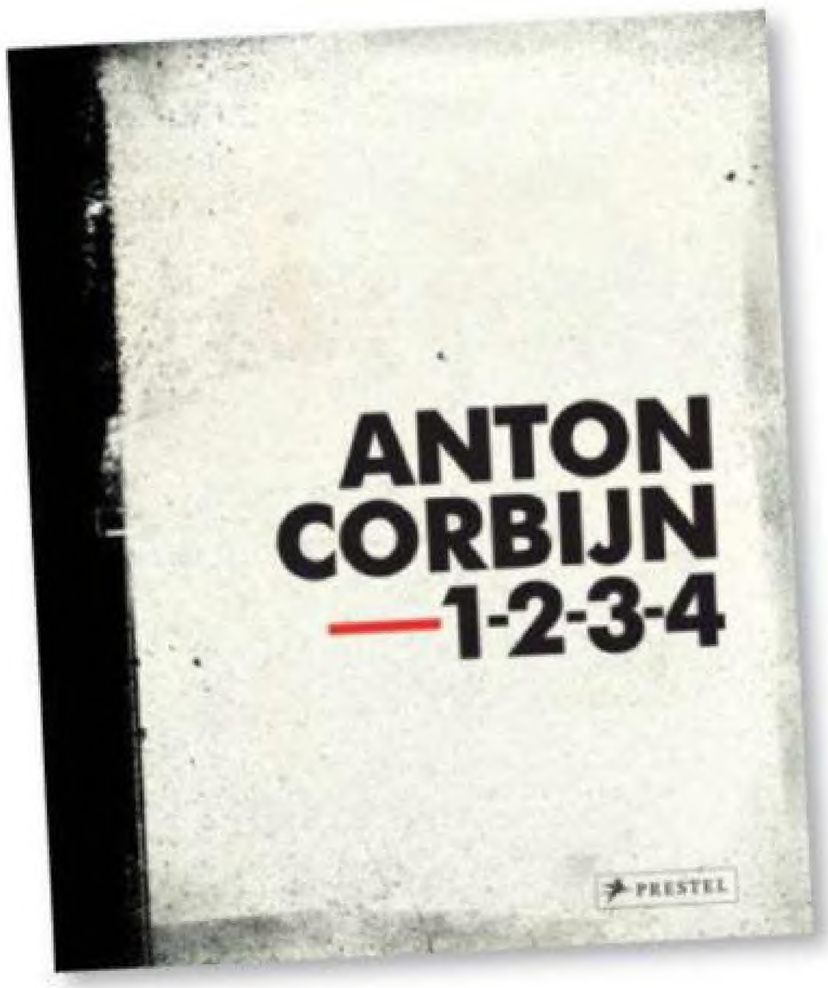
As well as providing a generic film profile, *ColorNeg*, *VueScan* and *SilverFast* all have built-in profiles for a range of film types from various manufacturers. Although this sounds promising, the profiles often produce less-than-ideal results, and you simply have to use trial and error to find out which profile produces the best results with your source material. Because film bleaches with age and the individual dye layers age differently, profiles with fixed parameters are only of limited use. To combat these issues, scanner software packages offer various automatic correction options. *SilverFast*'s Auto CCR functionality reliably reduces conventional color casts and those caused by bleaching, and obviates the need for further color tweaks. The 'Restore fading' option in *VueScan* has a similar effect to Auto CCR, but the results are often not as realistic. The 'Restore colors' option was no use at all and produced severe color shifts in all our test images. To select the generic profile in *Silverfast*, select the 'Other' option in the Source, Vendor and Film Type lists. If you take this route, you will still have to adjust the resulting colors manually



The *SilverFast* Negafix module has around 120 built-in film profiles. Exposure and Tolerance can be adjusted manually as necessary.

c't

Book Review



Anton Corbijn

1-2-3-4

1-2-3-4

Anton Corbijn
Published by Prestel
352 pages, 300 photos
11.7 × 9.7 inches
Hardcover
$49.99
ISBN: 978-3-7913-8182-4

The cover of this oversize book has a velvety feel that arouses your curiosity the moment you pick it up. Its 352 pages cover more than half a century of rock and pop portraits by probably the most influential photographer on the music scene. The images immediately conjure up the music behind them and make you want to dig through your record collection and relive those magic moments.

Through his friendships with many well-known musicians, Anton Corbijn has unprecedented access to many big-name stars. He nevertheless withstood the temptation to fill this book with as many faces as possible, and there are repeat appearances by Nick Cave, Tom Waits, U2, Depeche Mode, Arcade Fire, the Rolling Stones and others.

Most of the images are in black and white and are printed on thick stock that makes flicking through the pages a fun, tactile experience. They are sorted neither chronologically nor according to the subject and aren't always accompanied by text, so every page is a surprise.

Although Corbijn tends to prefer serious expressions, his photos are still full of humor, often emphasized with masks or absurd poses like the one struck by Tom Waits in the shot reproduced below.

This collection offers a deep insight into Corbijn's multifaceted oeuvre, and taking a close look at the the backgrounds he uses, his lighting techniques and the way he uses shadow in his compositions is a great way to brush up your skills.

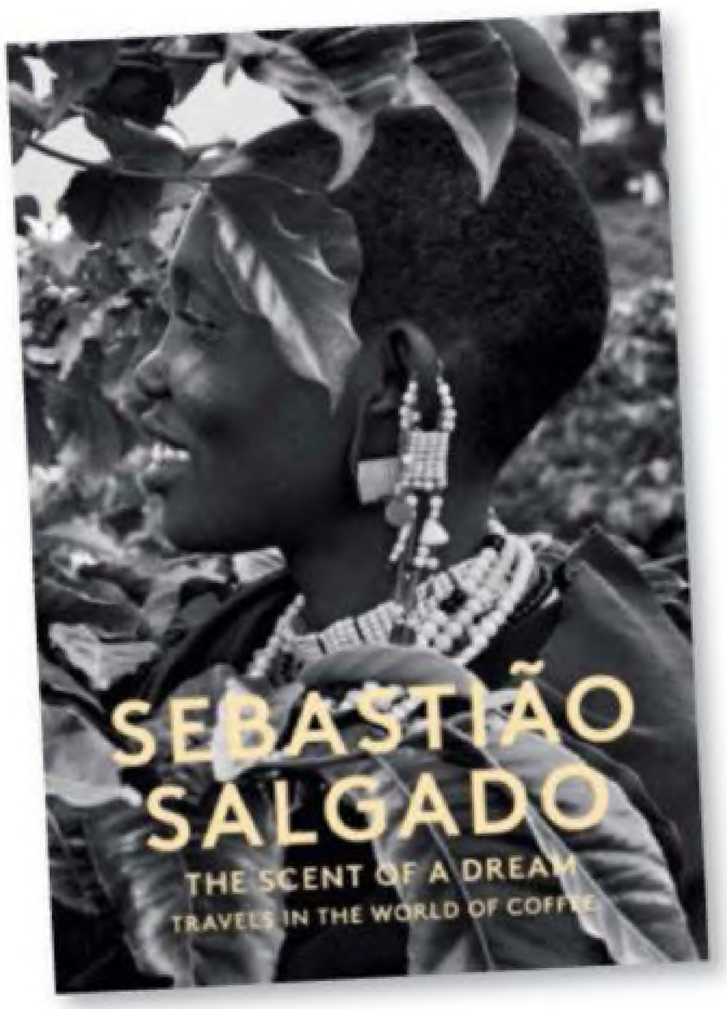
One of the most striking photos is one of Tom Waits in an almost submissive pose, playing his guitar to an apparently disinterested girl. Waits adds a few lines of text that underscore the power of the image and accentuate the symbiosis between Corbijn's visual prowess and the singer's own unique brand of lyricism.

This book was published to coincide with two exhibitions in Den Haag in Holland, held to commemorate Corbijn's 60th birthday. *1-2-3-4* takes stock of a long career and feels almost like a retrospective that draws an artistic era to its inevitable close. Although photography remains his number one passion, Corbijn has often said that in future he will be dedicating more time to film-making. (jr)

Tom Waits, Santa Rosa, 2004 (Copyright Anton Corbijn)

Tom Waits sitting on a drum in the middle of the street.

Anton Corbijn plans his shots very carefully and likes to portray the real-life character behind the star persona. Serious expressions coupled with funny or bizarre situations are the unmistakable hallmarks of his unique photographic style.



The Scent of a Dream

by Sebastião Salgado
Abrams Books
$75.00
320 pages, 150 photos
10 x 14.2 inches
Hardcover
ISBN: 978-14197-1921-9

The Scent of a Dream

Sebastião Salgado

In this book, the master of the documentary photography, Sebastião Salgado, returns to his roots and revisits the coffee industry where he began his working life in the 1970s as an economist for the International Coffee Organization (ICO). It was during this phase that he discovered his love of photography while visiting African coffee plantations. He soon gave up his job to concentrate full-time on documentary photography.

Social commentary has always been a cornerstone of Salgado's work, and the world of coffee production – which employs around 25 million people in 42 countries – is no exception. Most workers in the coffee industry are laborers, and it is they who are the focus of the images in this book, captured on a journey through ten countries on three continents. He dedicates the book to those who plant, harvest, clean, and dry the countless coffee beans that eventually find their way into our coffee cups.

These images appear to come from a bygone era of simple living and hard manual labor. The working conditions are so similar in all of these photos that it is difficult to tell at a glance where they were captured, although a closer look reveals clues in the form of ethnic clothing and jewelry. Salgado complements his portraits with images of the plantations and the surrounding landscapes that show the close relationships that exist between these very different environments, and illustrate the sustainable methods used to grow coffee in many of the places he visited. It is nevertheless impossible to overlook the sheer size of the plantations and their importance to the people, the environment and the economies of the regions they are part of.

This book comprises 300 powerful images that often use extreme contrast and grain effects to underscore the harsh conditions they depict. The photos are, however, not accusatory and encourage you to reflect on the true value of a precious product that has somehow become a run-of-the-mill part of everyday life in the industrialized world. (tho)

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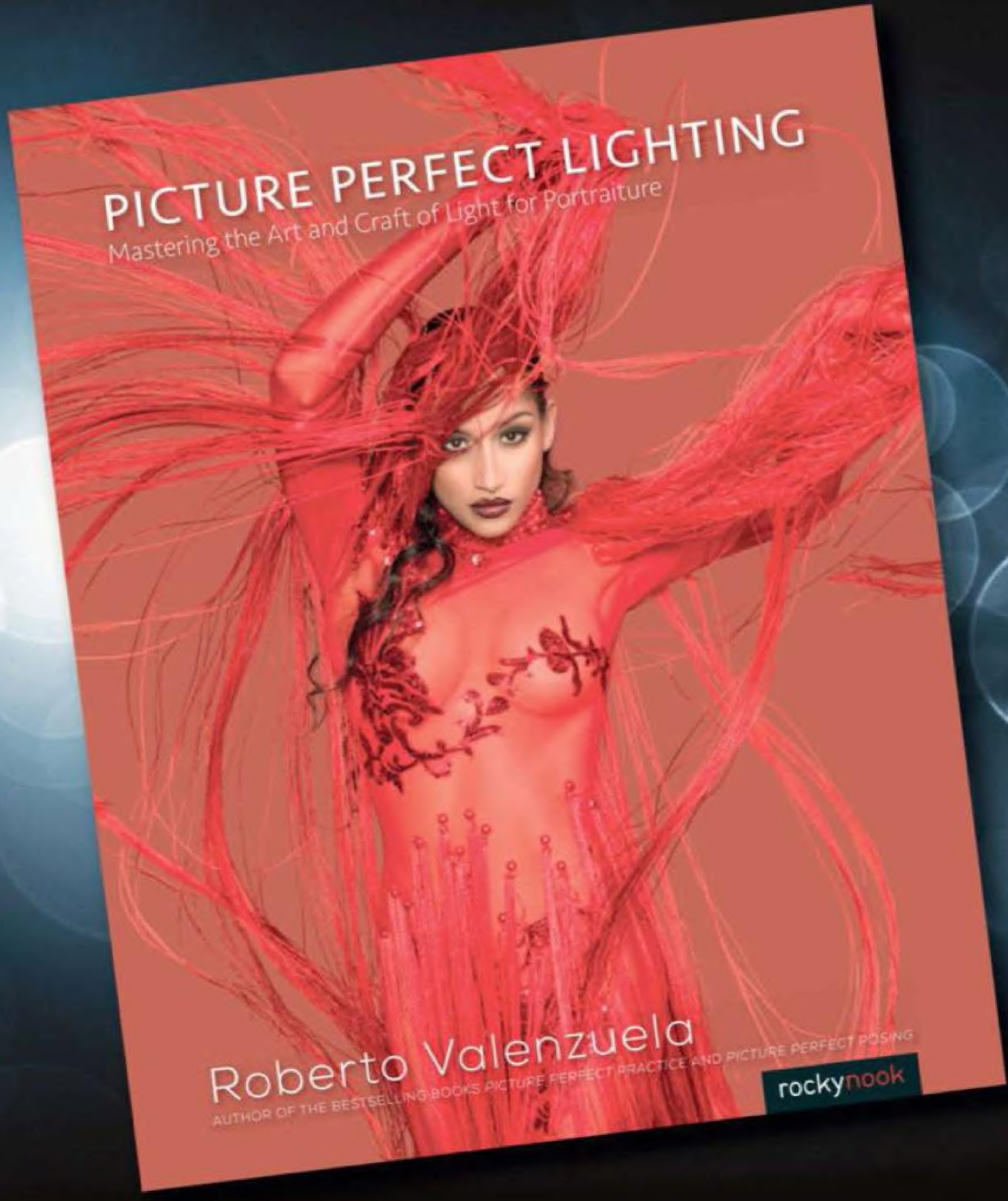

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